COMMUNITY BASED SCHISTOSOMIASIS CONTROL IN ZIMBABWE

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ABSTRACT

The project was established to investigate the feasibility of a national schistosomiasis control programme in Zimbabwe based upon an integrated approach. The project involved community self help sanitation and water programmes, health education, chemotherapy of school children with praziquantel, and focal molluscciding. The project was carried out in two rural areas of Zimbabwe with a combined population of over 40,000 people. Madziwa (32,000 people) had all of the above interventions, and Bushu (8,000 people) had only the chemotherapy intervention.

The different components of the project were evaluated in terms of their success, feasibility and impact by various methods.

Infection with schistosomiasis was determined by the use of reagent strip examination for haematuria. This low cost method of diagnosis was found to be very appropriate and feasible for the examination of large numbers of children and the method was recommended for use in a national control programme.

Pretreatment infection levels with schistosomiasis generally exceeded 60% in both areas although there was considerable heterogeneity in distribution. The treatments had a marked effect on prevalence as shown by reexamination of school children and from annual age prevalence surveys. Reinfection was rapid especially in the age group 7–9 years which also showed the greatest recurrence of heavy infections.

The sanitation programme was very successful with 2455 latrines completed of which 53.4% were double compartment latrines. The problems in implementation are discussed in detail and an evaluation of structure and function, while revealing many defects in construction, also showed that the latrines were acceptable and used by the majority of the household members. An adoption survey showed that families who built latrines were wealthier than average and had larger families.

The water programme was slow to start and presented many problems. By completion of the project 104 of the target of 150 hand pumps had been installed. Techniques were modified during the project and several important operational issues were highlighted. A major issue is related to the operation and maintenance of the installed pumps which began in an unsatisfactory manner. The issue is not likely to be resolved without further policy developments in the country and is part of an issue receiving national attention.

Washing slabs were constructed at most boreholes and surveys of water use indicated that they have an important impact on water contact behaviour.

Assessment of the effect of the health education programme from knowledge attitudes and practices surveys as well as from school questionnaires indicated that it did not have a big impact. The difficulties experienced in this programme and the success of school drama competitions suggested that more use should be made of educational institutions in dissemination of health education messages.

Snail surveys provided good baseline data on seasonal patterns of population size and transmission although there was no clear evidence of a reduction in transmission following the treatment programme.

The comparison between Madziwa and Bushu to reveal the effects of the water

and sanitation programme on transmission are to be measured in a follow up study. The present data did not show any measurable differences at the levels of analysis so far attempted.

Recommendations are given on the feasibility of a national control programme for schistosomiasis. The rapid reinfection rates following treatment suggest that chemotherapy may have to be repeated at an economically unacceptable frequency. For this reason the national policy of linking schistosomiasis control very closely with water and sanitation programmes is fully endorsed.

ACKNOWLEDGEMENTS

We would like to thank the people of Chaminuka District for working together with us in the beginning of what we hope will be a continuing process of social development. The project was jointly carried out with the Provincial Medical office in Bindura under the direction of the late Dr. E. Minya and Dr. R. Munochiveyi. We are grateful for their support and particularly the dedicated contribution of the staff based in Madziwa and Bushu. In particular we would like to mention the late Mr S. Rusere, Mr N. Masoswe, Mr W. Kavenga and Miss P. Chitanda. Staff of the Blair Research Laboratory who provided technical support, often for long periods in the field, deserve special mention and they are Mavu Zhou, Morris Chomwecho, Martin Nyatoro, Chris Tarambwa, Jeanette Clarke, Larry Jowah and Miwa Mekanica. Finally we would like to thank IDRC for financial support.

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Chapter 1

INTRODUCTION

1.1 IMPORTANCE OF SCHISTOSOMIASIS

There are two kinds of human schistosomiasis in Zimbabwe, the bowel form called *Schistosoma mansoni*, and the bladder form called *S. haematobium*. The general life cycle differs only slightly between these two species although sometimes these differences are very important.

The adult schistosome worms live in the blood vessels of man usually around the gut or the bladder. The worms themselves are not very important in producing disease as it is the accumulation of the eggs produced which gives rise to most of the symptoms of schistosomiasis. Some of the eggs produced by the worms pass through the gut or bladder wall and thus to the outside in the stool or urine. Mature eggs will hatch if they reach water and the young stages produced (miracidia) search for the next host which is the snail. After penetrating the snail a cycle of asexual reproduction takes place which results in the production of thousands of cercariae from one miracidium. These cercariae are released into the water by the snail where they search for the next host which is man. On penetrating human skin the cercariae rapidly change into juvenile worms and move through several parts of the body before finally settling (usually) in the blood vessels of the gut or bladder reaching maturity and producing eggs about 6 weeks after infection. The average life span of schistosome worms is about 4–5 years and they produce about 2–300 eggs per day.

Schistosomiasis can have severe effects on man resulting in paralysis or death but more commonly it is believed to be a debilitating disease which reduces the capacity for work, increases susceptibility to other infections and exacerbates malnutrition. Long periods of infection result in a greater risk of bladder cancer in middle age. The most obvious symptom to the rural infected population is the presence of blood in the urine which is typical of *S. haematobium*. *S. mansoni* infection may result in diarrhoea and the presence of blood in the stool.

Recent work has shown by ultrasound examination that a great deal of pathology is hidden and is much more common than previously believed (Degremont et al, 1985). Ultrasound examination of infected bladders in Zimbabwe has shown a very high frequency of fibrosis but in addition examination of the kidneys has shown that 1% of infected children may have unilateral hydronephrosis. Liver examination by ultrasound in *S. mansoni* cases shows little damage in Zimbabwean children (about 2% with mild to moderate liver fibrosis) but infected adults show a frequency of over 30% with moderate to severe liver fibrosis.

1.1.1 Schistosomiasis in Zimbabwe

A considerable amount of research has been carried out on schistosomiasis in Zimbabwe however there are at present no operational control programmes in any rural area of the country. Schistosomiasis control programmes are limited to areas of special interest such as irrigation schemes and recreational sites where there is an increased risk of transmission. Experimental control programmes have in the past been based on a single intervention measure such as chemotherapy (Cook et al, 1977; Jewesbury et al, 1975) snail control (Barnish et al, 1980) water supplies (Jordan et al, 1975) with or without health education whereas large national or regional programmes (Brazil, Egypt, Congo, Sudan) rely largely on molluscicides and chemotherapy.

The major drawback of these programmes has been one of cost, the commercial molluscicides are prohibitively expensive, many of the drugs are expensive in themselves or in the manpower requirement to supervise safe administration, and safe piped water supplies also pose a major financial problem for developing countries. Large schistosomiasis control programmes which have been instituted in Egypt, Sudan and Brazil continue to require large external financial resources to maintain their operation. Estimated costs of schistosomiasis control have varied from US$1–4 per capita protected, more than 50% of the per capita health budget of many developing countries (Jordan, 1985).

With the development of new and safe drugs for the treatment of schistosomiasis, chemotherapy has become an acceptable approach for the control of this disease. High cure rates are achieved and if egg excretion persists the intensity of infection is greatly reduced. The most acceptable and realistic objective of any schistosomiasis control programme must be a reduction in the morbidity due to the disease. As schistosomiasis is a quantitative disease, that is a few worms are less important than many worms, effective reduction in morbidity does not require the interuption of transmission but the more realistic and achievable aims of a reduction in the *intensity* of transmission with a reduction in the *intensity* of the infection in man. The latter may or may not be accompanied by a decrease in prevalence.

Poor sanitation and water supplies in the rural areas of Zimbabwe as well as in other developing countries contribute considerably to the transmission of schistosomiasis. The reduction of prevalence of schistosomiasis by chemotherapy will have little if any, long term effect without reducing the amount of human contact with natural water sources. In areas with no adequate sanitation people have no choice but to pass their excreta in the bush and often the best cover is provided along water courses. In rural areas without adequate protected water sources it is fruitless to advise people not to have contact with rivers and dams

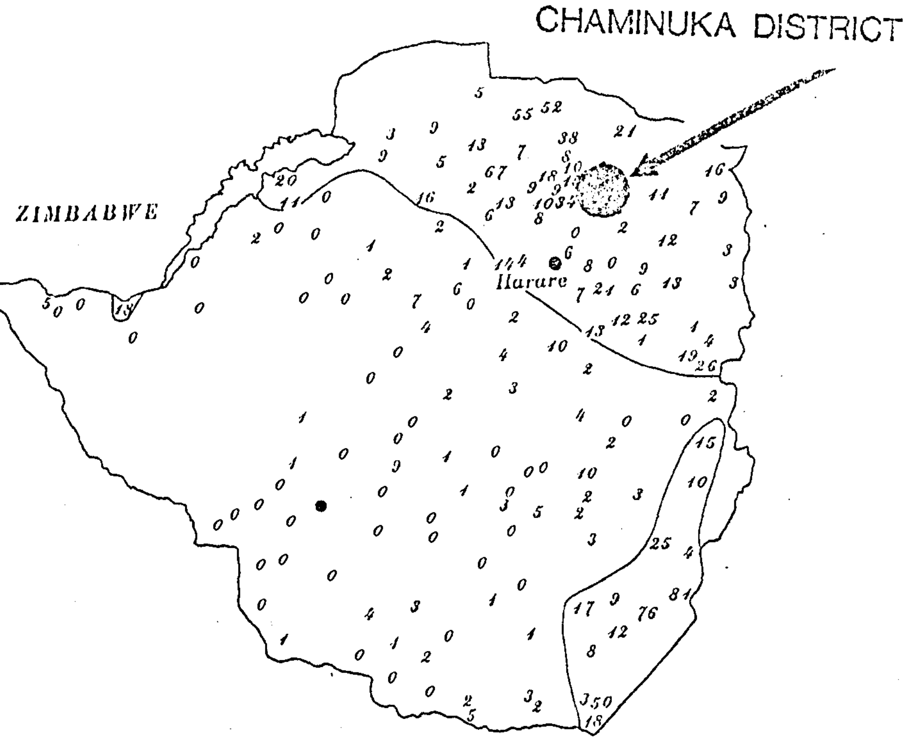


Figure 1.1: Prevalence of *S. mansoni* in 8–10yr old school children in Zimbabwe. The percentage positive are shown overlying the location of the school. The location of Chaminuka District is indicated.

as this is done of necessity. For the maintenance of schistosomiasis control over a long period it is therefore essential that the community be provided with adequate sanitation and safe water and through health education be aware of how they can use these facilities to improve their own health.

Macdonald (1965) showed that a partial reduction in the amount of water contact would have a greater effect in reducing schistosomiasis transmission than would similar reductions in snail population or contamination. This therefore should represent a major line of attack on schistosomiasis for the long term maintenance of control or even interruption of transmission.

Schistosomiasis is the most common parasitic infection in Zimbabwe and is second only to malaria in terms of morbidity. *S. haematobium* has also been linked with the prevalence and frequency of transitional cell carcinoma of the bladder in Zimbabwe (Thomas et al, pers comm).

The distribution of schistosomiasis in Zimbabwe has been reported previously (Taylor & Makura, 1985) and is shown in Figures 1.1 & 1.2. The north east of the country has the greatest prevalence of schistosomiasis and this is ascribed mainly to the higher rainfall which results in even small streams being perennial. The Midlands and the south east of the country are moderately affected with schistosomiasis and the lowest levels of infection are found in the drier western regions. It is, however, difficult to generalise as far as schistosomiasis is concerned as the transmission of the disease is very focal and greatly dependant upon the

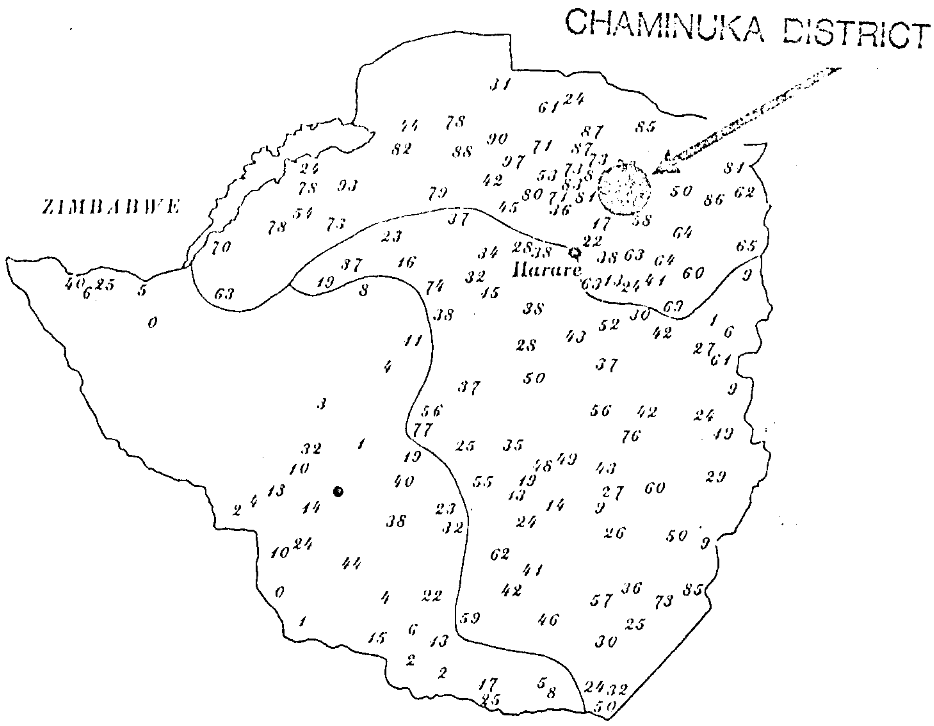


Figure 1.2: Prevalence of *S. haematobium* in 8–10yr old school children in Zimbabwe. The percentage positive is shown overlying the location of the school.

amount and type of water contact. High frequency of water contact increases the risk of contracting, and also spreading, schistosomiasis. Thus in areas where there is a low overall prevalence of the disease there may be isolated foci, usually associated with a dam or river, where there is a very high infection rate. This focal nature of the transmission of schistosomiasis means that not only is it very difficult to generalise on the importance of the disease in an area but it also means that any activity which increases the amount of surface water available or the amount of water contact activity is almost certain to increase the risk of schistosomiasis.

1.1.2 National Control Policy

The Ministry of Health has adopted a strategy for the national control of schistosomiasis (Taylor, 1986). The broad objective has been set as the reduction of morbidity due to schistosomiasis and more detailed targets were set for the next five years. It is recognised that we now have the tactics available to be able to achieve satisfactory control over the disease through snail control, safe water supplies, adequate sanitation, health education and chemotherapy. The first four techniques will be embodied within the primary health care (PHC) system and will be aimed at consolidating advances made through chemotherapy (Mott, 1984; World Health Organisation 1983).

As has been undertaken in Brazil (Machado, 1982) the Zimbabwean programme will be an integrated one. The PHC system is a broad based approach to health care which recognises that many factors affecting health are inter related. This inter- relationship is most clearly seen in the areas of water supply and sanitation which are related not only to schistosomiasis but to other major health problems such as diarrhoeal disease, malaria, and trachoma. As such, a country with an active PHC system may not need to embody these activities within a schistosomiasis control programme but simply to strengthen them within the existing system. Zimbabwe's water and sanitation programme, already very active, has been reinforced by the dependence of the schistosomiasis control programme on its success.

Although Zimbabwe has not embarked on any large scale treatment programmes as yet, a major part of the future schistosomiasis control programme is already being undertaken through the water and sanitation activities of the PHC system.

The high prevalence of schistosomiasis in some areas of Zimbabwe may be ascribed to the greater amount of surface water available in these areas (Taylor & Makura, 1985; Clarke, 1966). However the underlying reason for schistosomiasis transmission lies in the lack of adequate sanitation, enforced contact with unprotected water sources for water supplies, and a lack of community understanding about the transmission of schistosomiasis.

The development of new and safe drugs for the treatment of schistosomiasis combined with development of simple rapid and quantitative diagnostic tests makes the screening and treatment of large numbers of people a feasible proposition and an important part of a control programme. However mass drug administration alone is not considered an acceptable strategy for long term control and must be accompanied by basic improvements in other factors affecting transmission of schistosomiasis. Principal amongst these are the poor sanitation and limited access to safe water in most rural areas. It is therefore envisaged that the key components in the implementation of schistosomiasis control in Zimbabwe are the provision of safe water and adequate sanitation. No mass chemotherapy programmes will be implemented in any region until improvements have been made in these two areas.

Zimbabwe is making considerable progress in implementation of programmes for improved sanitation and water in rural areas due mainly to the motivation of the rural population (Figure 1.3). Prior to the implementation of large scale schistosomiasis control programmes several questions affecting procedure, implementation and evaluation need to be addressed and this is being undertaken in a pilot study in an area of high endemicity with a population of about 40,000 people.

1.2 OBJECTIVES OF THE STUDY

1.2.1 General Objective

To design implement and evaluate an integrated community based schistosomiasis control programme within the Primary Health Care system of Zimbabwe.

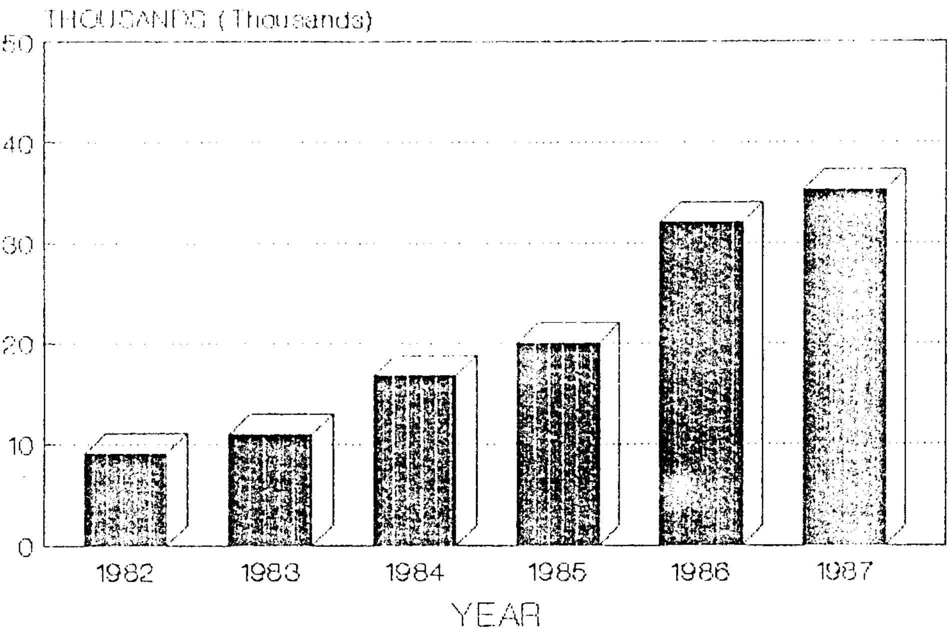


Figure 1.3: Annual number of latrines constructed in rural areas of Zimbabwe, 1982–1987. (After Waterman & Cross, 1988)

1.2.2 Specific Objectives

- To develop and evaluate a self help programme for the improvement of water and sanitation systems in a rural community.
- To develop and evaluate a community based health education programme aimed at schistosomiasis control.
- To compare the effect of the integrated programme in the study area to a control area using chemotherapy alone.
- To make recommendations regarding the feasibility of the various aspects of this programme for implementation on a wider or national scale.

1.3 STUDY DESIGN

The general objective of the pilot programme is to develop and evaluate an integrated community based schistosomiasis control programme within the primary health care system.

The area chosen has a population of 40,000 people and is situated in an area of high schistosomiasis endemicity (Figures 1 & 2) in the north east of Zimbabwe. In general *S. mansoni* is not of a very high prevalence and *S. haematobium* is the predominant human schistosome (Figures 1 & 2). The population, as in many parts of Zimbabwe, are highly motivated toward self help programmes particularly in the area of sanitation and water supplies. The pilot project takes advantage of this in the implementation of the programme.

The pilot programme has two major inputs; Firstly the *implementation* of the programme through the participation of the community and the health services and Secondly, the *evaluation* of the programme through a research input.

1.3.1 Implementation

1. The improvement of sanitation. A commitment was given by the community toward the target of one ventilated improved pit latrine per family. The family was expected to dig the pit for the latrine, provide the bricks, and either build the toilet themselves or pay for a builder from the community. The health service (or donor) provided cement, flyscreen, reinforcing wire, technical advice through the Village Community Workers and Health Assistants and training for builders.

2. The improvement of water supplies. Initially the community was largely dependant upon unprotected water sources. The scattered nature of most of the rural settlements in Zimbabwe make it difficult to provide safe water points for all households and therefore priority is being given to areas of greatest population density. The project aimed to provide one protected water point for every 25 to 30 families although due to the scattered nature of the settlements they would probably only be accessible to 5 to 15 families. The community is responsible for digging the well and subsequent maintenance of the simple pump installed while the health service provided the pump.

3. Health education. Knowledge of schistosomiasis and health related to hygiene, safe water and sanitation are fundamental in an integrated schistosomiasis control programme. Primarily responsible for implementing the health education component were the Village Community Workers (VCW) who act through discussion, example, talks and drama. Drama is increasingly being recognised as a vibrant and effective means of communication with which the community can fully identify. In other areas of the country education through drama is actually being carried out by the community itself. Other media of vital importance is the literature support for the construction and maintenance of toilets and water supplies. This area has been a difficult one to address in the past but we were fortunate to have developed several new materials in this field recently and which were available for the project. Locally produced films on schistosomiasis and water and various posters were also available for use.

4. Snail control. This was not envisaged as being practical for the study community or a national control programme due to the expense and expertise required in the application of commercial molluscicides. A single application

of niclosamide was considered for major contact points (Shiff et al, 1979) to support the impact of the initial chemotherapy.

5. Chemotherapy. This is a direct health service action. The highest prevalence and intensity of infection is found in school age children. They are also the most accessible sector of the population. Treatment was therefore directed at the most heavily infected group, the school children, to be carried out every six or 12 months in schools with diagnosis being made on the basis of the presence of blood in the urine as determined by urinalysis.

1.3.2 Evaluation

Evaluation was undertaken to measure the impact of the control programme as well as assess the value of some of the approaches used and their potential use in a national schistosomiasis control programme.

1. A knowledge attitudes and practices survey undertaken at the beginning and end of the study measured the impact of the education programme, changes in the proportion of the population with latrines, and changes in water contact behaviour.

2. An annual age prevalence survey was undertaken to measure the impact of the control programme.

3. Parasitology for *S. haematobium* and *S. mansoni* was undertaken on a 20% sample of school children during the treatments to assess the impact of treatment on prevalence and intensity of *S. haematobium* and *S. mansoni* and to evaluate the sensitivity and specificity of the reagent strip diagnosis.

4. Snail surveys were undertaken twice yearly to monitor the infection rates in the vector population.

5. Sentinel animals were used to measure the transmission potential of water bodies twice annually.

6. Sanitation and water interventions were monitored through progress reports and surveys of completed structures for structure, usage and maintenance assessment.

7. Health education activities were evaluated in adult females through the KAP surveys and in school children by questionnaire.

8. Data were compared for an area with all interventions to an area with only a chemotherapy intervention.

Chapter 2

METHODOLOGY

2.1 STUDY AREAS

The study areas are Madziwa and Bushu Communal Lands which make up Chaminuka District in Mashonaland Central Province of Zimbabwe (Figures 2.1 & 2.2).

The District is the lowest level of intersectoral collaboration in the administrative structure of Zimbabwe. The District is run by a District Administrator and a District Council. The District Council is made up of elected representatives from each Ward. Within a District are several Wards each with a Ward development committee (WADCO). The Wards are made up of five or six villages with approximately 1000 people in each. The chairman of the village development committee is the village representative on the WADCO.

Madziwa communal land has an area of 21 000 hectares and a mountainous terrain with many streams and four major rivers which have water for the most of the year. There are three dams in the area. The population was estimated in 1982 to be 32 000 people whose livelihood is based on subsistence farming with occasional commercial output. The people in the area are involved in most water-related activities which make rural life possible. There are nine Wards and 49 villages in Madziwa.

There are twenty schools in the area: 19 primary and 7 secondary with an enrolment ranging from 200 to 1 500 students and the age range is 6 to 21 years old

Bushu Communal Land has an area of 13,000 hectares and a population in 1982 of 8,000. In other respects it is similar to Madziwa with perennial streams and most of the population relying on subsistence farming as a livlihood. Bushu with three Wards and 16 villages has five primary and one secondary school.

Christianity is the religion of the majority followed by traditionalist and the apostolic faith.

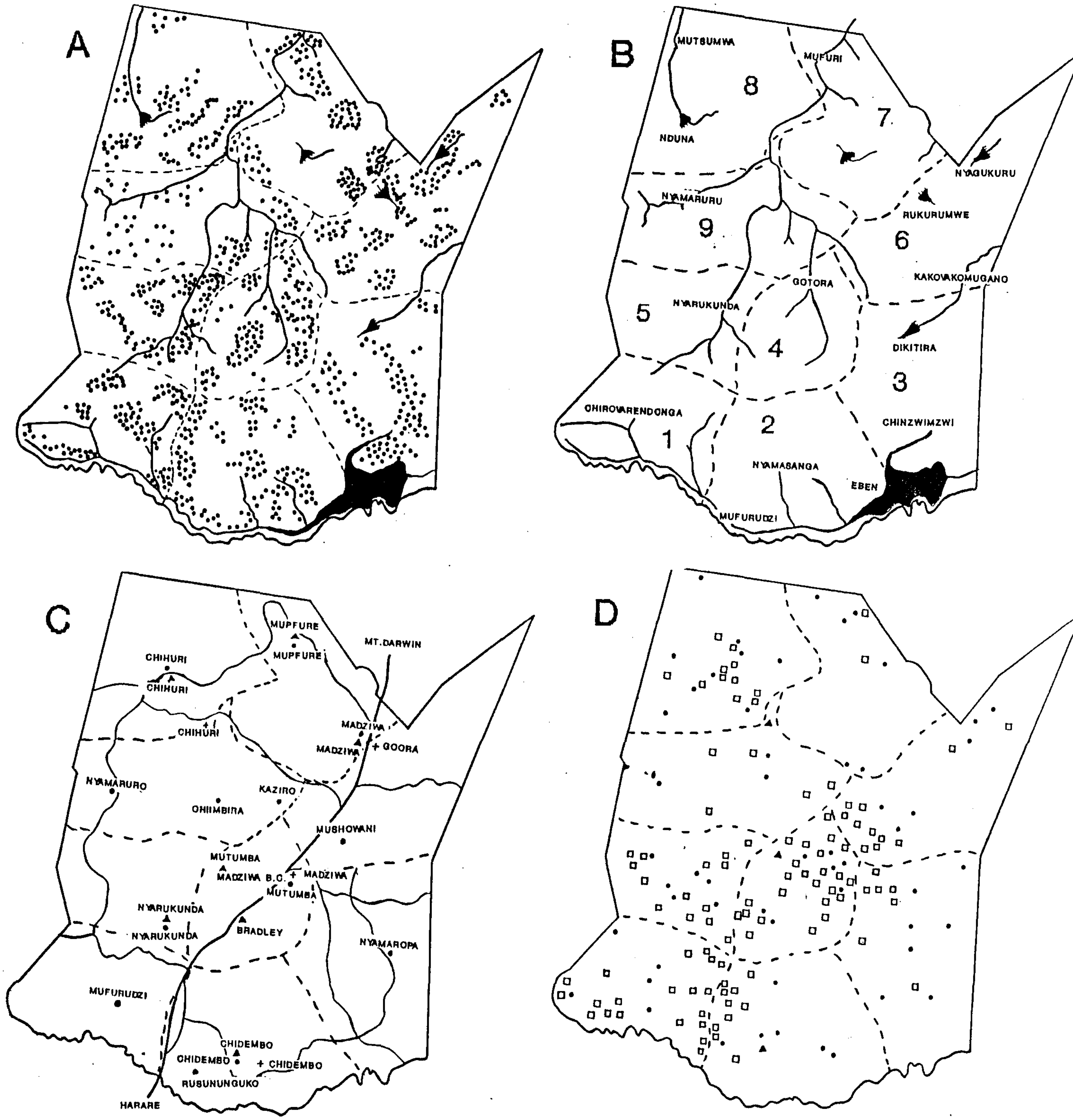


Figure 2.1: Madziwa Communal Land. A. Population distribution and ward boundaries. B. Permanent waterbodies, Ward numbers and boundaries. C. Primary schools (closed circles), secondary schools (closed triangles), clinics (+), and roads. D. Water supply points. Bush pumps (closed circles), Blair pumps (open squares) and monopumps (closed triangles).

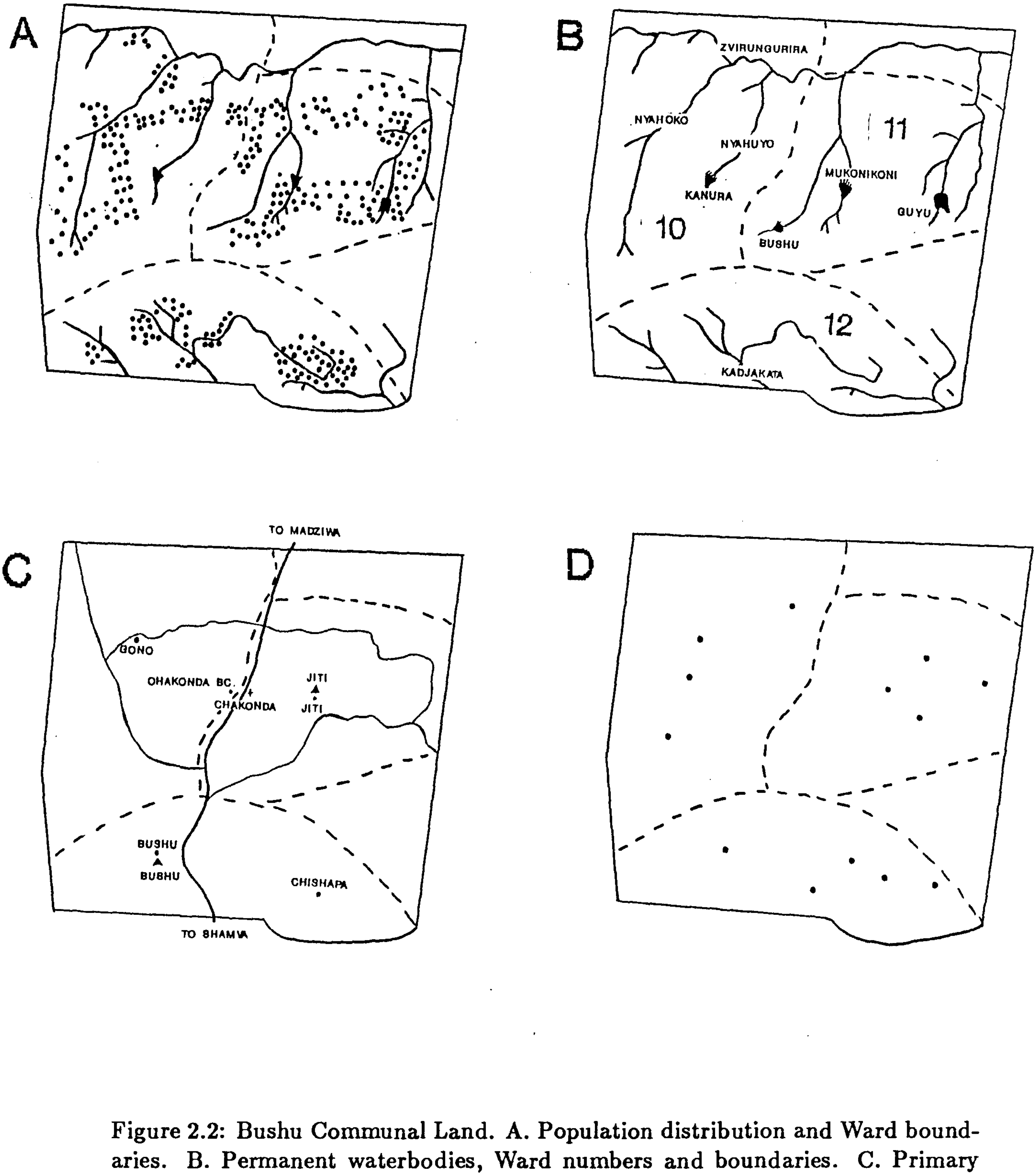


Figure 2.2: Bushu Communal Land. A. Population distribution and Ward boundaries. B. Permanent waterbodies, Ward numbers and boundaries. C. Primary schools (closed circles), secondary schools (closed triangles), clinics (+) and roads. D. Water supply points. Bush pumps (closed circles).

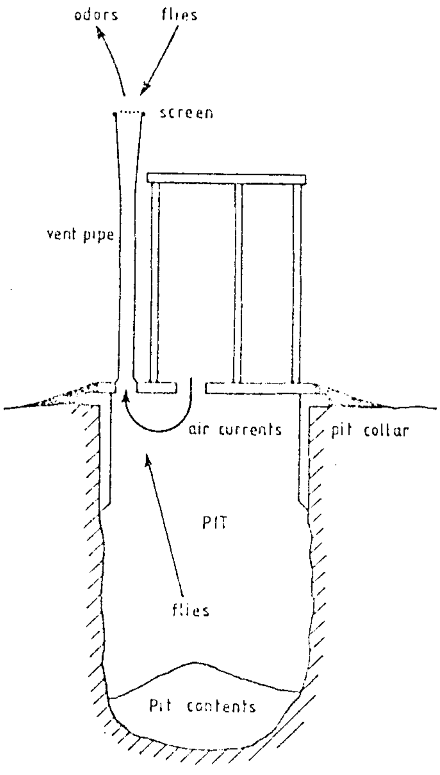


Figure 2.3: Blair ventilated improved pit latrine. Schematic diagram from Morgan & Mara, 1982.

2.2 INTERVENTIONS

2.2.1 Sanitation Programme

Zimbabwe has adopted the ventilated improved pit latrine (Morgan, 1977) (Figure 2.3) as the technology of choice for rural sanitation and this is promoted countrywide. The primary implementating agency is the Ministry of Health (MoH) although there is also much individual and NGO activity. For motivational and logistic reasons the funding agency provides one subsidy of locally unobtainable materials for one single compartment latrine per household. These are usually 5 pockets of cement, some reinforcing wire and a gauze mesh (fibre glass, stainless steel or aluminium) for the vent pipe. The subsidy is at a current rate of about US$28 per latrine. Construction and continuing maintenance are a family responsibility with the MoH providing a limited financial subsidy and technical advice. The general approach of the programme in Madziwa was as follows;

The MoH would provide the inputs listed above and the community or family would be responsible for digging the pit, collecting sand and gravel, providing bricks and constructing the latrine. The MoH carried out training courses for local builders on how to construct the latrine and these skills were therefore introduced into the community. Most families would contract with a local builder to construct the latrine at an agreed price of about US$27 for a single compartment and US$32 for a double compartment version. The additional cement required for a double compartment latrine was to be purchased by the family.

The latrine construction programme began in August 1985. Motivation was effected through meetings with the District Council and the District Health team, Village Health Workers and health education activities.

Cement and other materials were initially issued at the request of the village chairman when 5–10 families were ready to construct the latrine. The pits were inspected by the health assistant and he ensured that materials had been gathered for the construction and then the cement, reinforcing wire and gauze wire were issued on signature together with promotional literature on how to build and how to maintain the latrine. Later families collected their own cement from a central depot once they had the materials ready for construction of the latrine. The record form was used as a basis for future follow up by the health assistant when progress on the latrine would be recorded as well as the date of completion.

These forms were used as the basis of monthly summaries of the progress of the programme. At the end of the implementation programme on the last follow up of uncompleted latrines the owners were asked the reasons why they had not yet completed building the latrine.

Adoption study

In order to identify which sector of the population was taking up the offer of free material for latrine construction a questionnaire was administered to a random sample of villagers. The sample was obtained by randomly selecting two villages per ward and within each village four families with a latrine and four families without a latrine (adopters and non adopters respectively). The non adopters were taken as the nearest neighbour without a latrine to the family with a latrine. The questionnaire was administered to the female head of the household. No leading questions were asked and the respondent was not prompted with possible answers. The questionnaire was precoded and pretested to ensure that the coded range of responses was adequate. Questions were asked in Shona, the local language, and all by the same field worker.

Construction

Builders were trained in how to build double compartment and single compartment latrines. Due to the size of the programme it was not possible to supervise the construction of each latrine although many problems were solved on follow up and by the holding of refresher courses for builders. A builders competition was held to identify the builder who had constructed the most and the best latrines.

Technical aspects of construction were evaluated by visiting latrines in each village of each ward to measure and observe the standard of construction. The sample was taken from those families with VIP latrines during a Knowledge Attitudes and Practices survey.

2.2.2 Water Supply

The National Action Committee for the International Drinking Water Supply and Sanitation Decade in Zimbabwe has approved several technologies for the supply of water to village communities. Most of the technologies were summarised in the National Master Plan for Rural Water Supply and Sanitation produced for the Ministry of energy and Water Resources and development by NORAD. The techniques suitable for scattered communities were considered and three approaches were adopted for the present project. Firstly additional wells would be drilled by the community using a hand operated drilling rig developed in Zimbabwe. Secondly, the simple Blair hand pump would be installed on suitable shallow wells with maintenance to be carried out by the community and thirdly washing slabs would be constructed at water points.

Supplies were available for the construction of approximately 150 protected wells in Madziwa which was about three per village. No resources were available for the protection of water sources in Bushu. At the time of the start of the programme there were forty boreholes with hand operated bush pumps in operation in Madziwa. Only two of these had any headworks which included a washing slab.

Two hand operated drilling rigs were purchased and made available to the villages in 1986. Blair pumps were purchased as needed. Community participation was encouraged by asking an input from the local people through their labour. The community was asked to dig a well together, provide bricks and river sand, help in preparation of rings for the well lining. Initially, the drilling rig was used by the community for digging out the well but certain parts of the area were too rocky and the rig did not prove very useful. The rig was therefore withdrawn and a move was adopted in which existing wells were identified for protection.

Washing slabs were also constructed so the community would do their washing at the protected water point. This arrangement also called for a significant input from the community by way of communal labour and bricks and sand provision. In 1987 the District Development Fund (DDF) (Ministry of Local Government, Rural and Urban Development) took more responsibility in the care and provision of community small water supplies and were very willing to participate in the water supply programme. They took the role of mobilising the communities to assist in the building of washing slabs at each of the boreholes in Madziwa.

DDF also assisted in the formation of a water subcommittee for the maintenance and repair of Blair pumps and the Bush pumps in the area. These water subcommittees were trained in the installation, care and maintenance of water facilities at several workshops and refresher courses. The DDF agreed to stock spare parts for these Blair pumps. The water subcommittees were to be representatives of the community in matters of water and they were to be fully involved in the installation of all pumps in their area. Maintenance cards were issued to the members of the subcommittees for each Blair pump,and a maintenance/repair record was kept on these cards.

2.2.3 Chemotherapy Programme

The treatment programme was based on school children in Madziwa and Bushu and did not attempt to cover the remainder of the population. Children (including some over-age pupils and some teachers) were examined for haematuria using reagent strips and all reagent strip positives were treated immediately with praziquantel at 40mg/kg. In order to evaluate the technique 20% of the children (every fifth child) were requested to provide a urine and a stool specimen for parasitological investigation. Diagnosis using reagent strips followed by treatment with praziquantel as outlined above took place during Jan/Feb 1986, Sept/Oct 1986 and Sept/Oct 1987. Examination of urine and stool specimens for haematuria, *S. haematobium* and *S. mansoni* infection was carried out as described below (2.3 Parasitology).

2.2.4 Health Education

Both Madziwa and Bushu had some health education input which came as an essential component of the schools chemotherapy programme. However, Madziwa was the main focus for additional health education activities. Information on schistosomiasis was distributed in schools and in the community of Madziwa. This information included pamphlets and showing of films on schistosomiasis. As part of the drive to reach those most at risk to infection, drama competitions between schools have been held on a yearly basis. All primary and secondary schools in Madziwa were invited to participate. The themes of the drama competitions were the relation of unprotected water sources to schistosomiasis, the adoption of good sanitary practices and the mode of transmission of schistosomiasis.

When each drama was judged the pupils and parents were invited to view the play. Five schools were invited to the finals, three primary schools and two secondary schools. The whole community was invited to view these plays. The finals were held at Independence and World Health Days. High ranking officials from the Ministry of Health and Ministry of Education judged these plays and presented prizes.

A constant interaction between staff of the Provincial Medical Director, Blair Research staff, Health assistants, Village health workers and the community provided a continual input of information related to schistosomiasis and other diseases to the area.

To evaluate the impact of the health education programme an exam type questionnaire was administered to a random sample of Grade 7 school children from Madziwa, Bushu and Mount Darwin. Mount Darwin is adjacent to Madziwa and Bushu and has had no schistosomiasis control programmes. Five schools in Madziwa, four from Bushu and four from Mount Darwin were randomly selected from the total schools listed. The children were each given one hour to complete the questionnaire. As the children are taught in English, the questionnaire was administered in English.

The children were notified as to the purpose of the exercise and that the results would not be used as a gauge of their school performance. All questions presented to the children were on issues integral to the schistosomiasis component of the Science syllabus taught in Zimbabwe schools. The questionnaire was pretested in order that all questions were worded acceptably and that the coded range of responses was appropriate. The method of item analysis was used when marking the test. All short answer questions were marked strictly against a sample marking schedule to avoid bias.

2.2.5 Molluscicidіng

During the initial mapping of the study areas all of the permanent water bodies were noted (Figures 2.1 & 2.2). As this was a drought year it was felt that this was truly indicative of sites with permanent water although persisting drought conditions caused some reduction in the number of sites in subsequent seasons.

Commercial molluscicide is too expensive for use throughout the rural areas in Zimbabwe. Because of this fact, it was only used once early in the programme in the experimental area, Madziwa. Molluscicide was applied with the objective of spraying all of the human water contact points. Two teams of two men each would walk on each side of the river and would spray a contact point. They would start at the source of the river or stream and work downstream to maximise the effect of the chemical.

The spraying was carried out at 10 metres upstream and 5 metres downstream from the contact point, spraying from the bank to the other side laying a pattern across the water. When spraying dams, the complete shore line was covered from the shore outwards to the edge of the vegetation and back in a series of arcs.

The mollusciciding was carried out during winter (July, 1986) following the recommendations of Shiff et al, (1979) that the maximum effect would be obtained by spraying at the season of low transmission when snail populations are also not actively reproducing. Niclosamide (Bayluscide) 70% W.P. made up into 50g charges was mixed in 8 litres of water and used as cover spray. During the operation carried out in Madziwa 123.6kg of niclosamide was used over a period of 17 working days.

2.3 EVALUATION AND RESEARCH

2.3.1 Parasitology

Haematuria was measured on freshly collected urine samples using Ames 'Hemastix' and the result graded from 0 (negative), through 1 (trace) to 4, representing increasing amounts of urinary blood on a qualitative scale. All reagent strip positives of trace and above were treated with praziquantel at 40 mg/kg. The presence of visible blood in the urine was recorded.

Urine samples were examined for eggs of *S. haematobium* by filtration (Mott, 1983) using a 13mm Nytrel filter and 5–10% Lugols iodine in saline was used to help visualise the eggs on the filter. Contrary to reports of Rhode et al, (1985) regular examination did not initially show any eggs remaining attached to the filters after washing although later with extensive checking very low numbers of eggs were rarely found attached to filters. No account has been taken of possible false positives in the interpretation of results but for the third examination and treatment (Sept/Oct 1987) filters were cleaned by soaking in 10% potassium hydroxide for at least 30mins before washing in the normal manner. The presence of visible blood in the urine was recorded.

Stool samples were examined for *S. mansoni* by the Kato technique (Peters et al, 1980).

2.3.2 Knowledge, Attitudes and Practices Surveys

In Madziwa and Bushu a knowledge, attitude and practices (K.A.P.) survey was carried out in 1985 at the beginning of the schistosomiasis control programme in the area. A second K.A.P. survey was conducted in September, 1988 in order to evaluate the impact of the schistosomiasis control programme on the populations attitude towards schistosomiasis and their sanitary and water contact patterns.

The survey was conducted in Madziwa and Bushu in Chaminuka District in the Mashonaland Central Province, and it was carried out in all the 9 wards in Madziwa and 3 wards in Bushu. Each ward consists of 5 or 6 villages. The sample was stratified by administering the questionnaire to five, occasionally six, households (HH) in each village, in each case to the female head of the HH. The first HH in each village was selected at random by the enumerator on arrival in the village and the remainder were taken on a nearest neighbour basis.

Questionnaires were coded for computor analysis. No leading questions were asked and the respondent was not prompted with possible answers. An answer received was coded by the enumerator and entered on the questionnaire. The questions were in the order of family composition, sanitation, water supplies and then schistosomiasis. The questions were open ended but the questionnaires were pretested to remove any ambiguity and to ensure that the range of codes for the responses was adequate. Interviews were conducted in Shona, the local language.

With the second KAP in 1988 there was also an evaluation of latrine construction. A section at the end of the questionnaire dealt with observations by the interviewers on the siting and quality of toilets which the family used. These were done through measurements of roof, vent pipe, door width, pit depth, roof slab thickness and distance of the toilet from the nearest dwelling, sloping floor, size of squat hole and presence of flyscreen.

2.3.3 Age prevalence surveys

Age prevalence is one of the indices recommended for use in establishing adequate baseline information and evaluating schistosomiasis control programmes . These studies were carried out in Madziwa and Bushu Communal Lands. Wards are made up of 4–6 villages with 500–1000 people in each village. Villages are not consolidated and houses are widely scattered over a relatively large geographic area. Within each village are between one and five extended family groups under the leadership of a *kraalhead.*

Age prevalence surveys for schistosomiasis were carried out in May 1985, 1986, 1987 and 1988. The population was sampled in a random stratified manner. Within each Ward a village was randomly selected. If there was more than one kraalhead in the village the kraalhead was then also randomly selected.

The people under a selected kraalhead were asked to meet at an agreed time by the village chairman. After an explanation of schistosomiasis and the programme; the people were asked to give samples of urine and stool in provided standard collection bottles by family group until approximately 100 people had been seen. School children from the family were followed up at school if not present.

Stool and urine samples were examined as described above (Parasitology)

2.3.4 Water, structure, function and usage

The implementation of the water programme was evaluated in several ways; the maintenance of the facilities was evaluated by the number of reports of breakdowns and the numbers of breakdowns found by health personnel when visiting pumps. The installation programme was evaluated by the progress in commissioning the estimated numbers of pumps. The usage of the facilities was evaluated by an observation/ questionnaire study.

The objectives of the water use survey were to assess the impact of the safe water supply programme in the schistosomiasis control area by:

- finding out whether the community had sufficient protected water sources.
- finding out whether the people were using the protected water points and the washing slabs.
- finding out what the community thinks about provision of such facilities.
- finding out which facilities are used more often and the reasons underlying such preferences.
- finding out which activities are carried out at water points and the time it takes to do them.
- determining what the community used to do before these facilities were installed.

Questionnaires were used in the survey. After a pre-test the interviewers went to randomly selected water points which fell into three categories namely, Blair pump on protected shallow wells, bush pumps on deep boreholes, and natural water bodies. A variety of questions were asked in Shona to the people who came to use the water points and other facilities present. Questionnaires were administered to as many people as possible of those visiting the site. In order to make sure that the interviewing was standardized the interviewers first did the questioning together before they did the actual survey. There was no prompting of interviewees.

The survey was conducted between 07.30 hours and 10.30 hours for comparison between facilities.

2.3.5 Sanitation; function, structure and usage

There were portions of the KAP questionnaire which dealt with observations by the interviewers on the siting and quality of toilets which the family used. These were done through measurements of roof, vent pipe, door width, pit depth, roof slab thickness and distance of the toilet from the nearest dwelling, sloping of the floor, size of squat hole and presence of flyscreen. Information on usage of the latrines was also collected in the knowledge attitudes and practices surveys.

2.3.6 Snail populations and infection rates

The intermediate hosts for *S. haematobium* and *S. mansoni* are *Bulinus (Physopsis) globosus* and *B. pfeifferi* respectively. In order to monitor the impact of the control programme on transmission of schistosomiasis, measurements of snail population size and infection rates were taken twice annually from 1985 to 1989. The surveys were done in April (post-rainy season) and October to November (pre-rainy season).

From the initial mapping of permanent water bodies 5 or 6 human water contact points were selected in each of the 12 Wards of Madziwa and Bushu although the number of sites was sometimes fewer due to dry conditions. A team of five workers, 1 research technician and four field orderlies did the surveys. The results were entered onto prepared forms. Snail populations were measured by collecting snails from each site using the fractional scooping method. Infection rates were determined both by examination of vector snails and by exposing hamsters at one site in each Ward.

Collection of snails

Snail surveys were done in the morning between 9.00 am and 12 noon. Snails were collected using the fractional scooping method of Shiff & Clark (1967). Using a standard scoop snails were collected from their habitats below the surface of the water for a distance of a metre without removing the scoop from the water but making sure that caught snails do not get dislodged accidentally by obstacles on or in water.This was done for the whole perimeter of the contact point and also at likely habitats within the site. Snails were identified and sorted into size categories based on maximum length in the case of *B. globosus* and maximum diameter in the case of *B. pfeifferi*. The three groups were small ($< 5mm$), medium (5–7mm) and large ($> 7mm$).

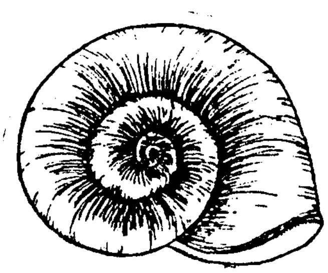
Snail infection rates

Individual snails were placed in 20ml plastic vials containing 10ml fishwater. The vials were placed in the sunlight or a shedding box with a 60 watt bulb and left there for 15 minutes. Then they were transferred to a dark place and remained there for 30 minutes before being transferred to the sunlight again for a further 30 mins. After this alternating light/dark/light process, the snail was removed and the vial contents were poured into a petri dish and Lugol's vital stain added to the dish to enhance visibility of any cercariae. Human type cercariae were counted under a dissecting microscope. To avoid overestimating infection rates from cross contamination only counts of five cercariae or more were considered indicative of infection. Snails which shed less than five (5) cercariae were thought to have picked them from the water which initially contained all the snails from the site.

Hamster Infection rates

Four or five hamsters *Mesocricetus auratus* were paddled at one site per Ward to determine infectivity of the water body. The same site was used on each sampling occasion. Each sentinel hamster was put in a floating cage for two hours for three consecutive days (Chandiwana, 1987). This made a total of six (6) hours of exposure for each hamster. The exposure exercise was carried out before the site was disturbed by scooping for snails.

The hamsters were kept at the laboratory for three months to allow for the maturation of the schistosome worms. After this period, the surviving hamsters were killed and perfused (Smithers & Terry, 1965) to recover schistosome worms. Both immersion and perfusion results were carefully entered on to prepared forms. Schistosome worms that were recovered were later identified electrophoretically (Mahon & Shiff, 1978). Schistosome eggs collected from the liver were also used in identifying the infecting schistosome species. The eggs were found in the liver while the worms were found in the mesenteric veins of the intestines. Terminally spined eggs were either *S. haematobium* or *S. mattheei* and laterally spined eggs, *S. mansoni*.



Chapter 3

RESULTS AND DISCUSSION

3.1 DISTRIBUTION OF SCHISTOSOMIASIS.

The first examination for schistosomiasis was carried out in the schools of Madziwa and Bushu in Jan/ Feb 1986. This provided the baseline data for the disease in the study area and allowed a description of the distribution of schistosomiasis in Madziwa and Bushu. The school parasitological data was examined by home village of each child allowing prevalence maps to be drawn up from village data.

The mean of the differences between prevalences of *S. haematobium* as diagnosed by parasitology and by reagent strip did not differ significantly from zero in any of the cases and therefore reagent strip results have been used in the descriptions of the distribution of *S. haematobium* (see also Reagent strip evaluation). This had the advantage in that a larger data set could be used.

The prevalence of *S. haematobium* in Madziwa as measured by reagent strip is shown for all school children and for 10–12 year age group in Figure 3.1. There is a considerable change in schistosomiasis prevalence and intensity with age (Taylor & Makura, 1985) as reported later, necessitating the consideration of a restricted age group. A different prevalence pattern is seen for the 10–12 year age group as compared with all children combined (Figure 3.1).

Similarly, the prevalence of *S. mansoni* is shown for all children and those aged 10–12 years (Figure 3.2). As these were parasitological results taken from a 20% subsample, the sample size is much smaller than for the *S. haematobium* reagent strip results.

The prevalence of schistosomiasis in 10–12 year old school children by school in Madziwa and Bushu is shown below (Table 3.1).

The mean of the differences of prevalence between *S. haematobium* diagnosed by parasitology and reagent strip for Madziwa schools was -4.2 (SD 9.7) which is not significantly different from zero.

The mean of the differences between the prevalence of *S. haematobium* diagnosed by parasitology and by reagent strip for Bushu schools was -3.3 (SD 7.1), which is not significantly different from zero.

Schistosomiasis can be seen to be most prevalent in the north east and south west of Madziwa where there is most surface water (Figure 3.1 & 3.2).The distribu-

Table 3.1: Prevalence of *S. haematobium* and *S. mansoni* in 10–12 year old school children, Madziwa and Bushu.

School	Ward	% PREVALENCE *S. haematobium* parasitology	*S. haematobium* reagent strip	*S. mansoni* parasitology
MADZIWA				
Mfurudzi	1	66.2	56.3	20.0
Chidembo	2	67.4	67.3	09.3
Rusununguko	2	79.2	80.0	42.9
Mutumba	3	59.4	63.8	17.2
Nyarukunda	4	56.5	49.2	06.6
Nyamaropa	5	75.9	75.4	19.6
Mushowani	6	60.0	68.8	12.1
Madziwa	6	60.4	88.0	20.5
Mupfure	7	76.9	81.3	19.2
Kaziro	8	75.0	73.0	37.8
Chiimbira	8	64.5	81.6	08.3
Nyamaruro	8	70.5	71.2	07.0
Chihuri	9	72.1	83.0	18.8
BUSHU				
Gono	10	83.0	81.3	12.2
Jiti	11	88.7	86.2	23.5
Bushu	12	47.4	49.5	06.7
Chishapa	12	47.4	62.7	00.0

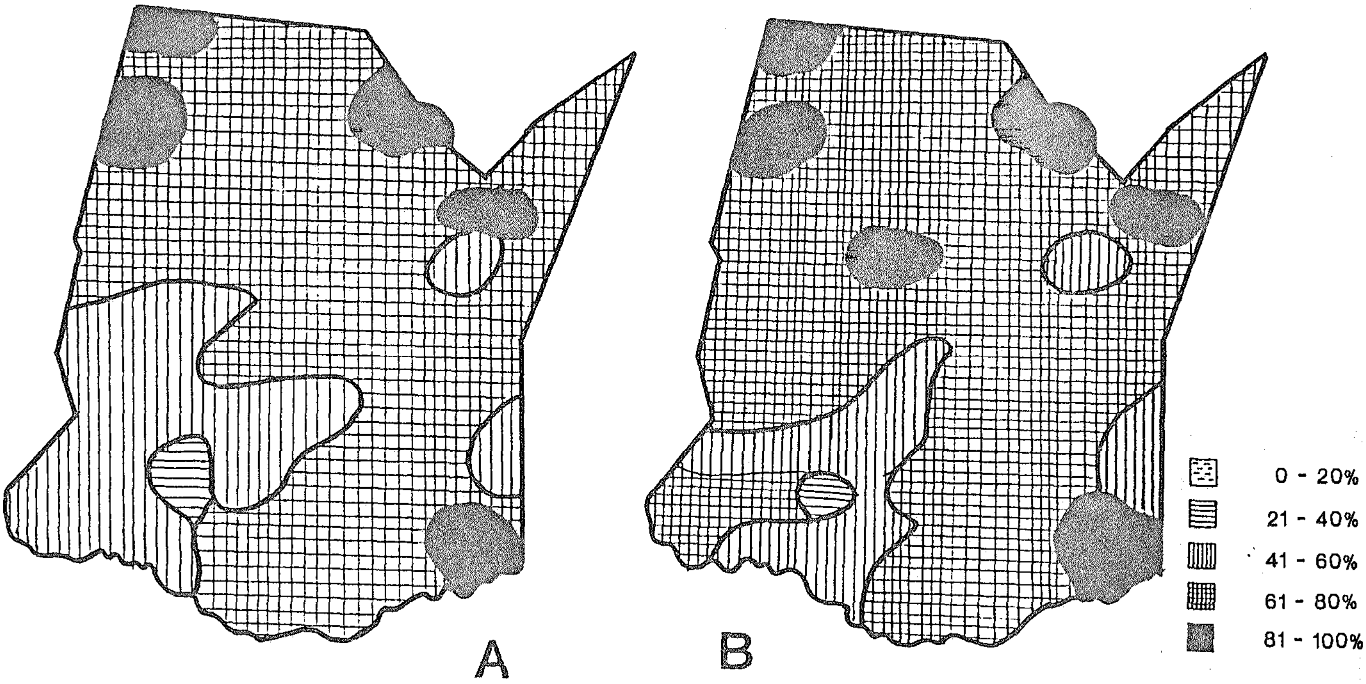


Figure 3.1: Preintervention distribution of *S. haematobium* by village in Madziwa. As determined from Jan/Feb 1986 reagent strip examination of urines from school children; A. all age groups, B. 10–12yr age group.

tion of schistosomiasis in Madziwa showed focal transmission with the prevalence varying from village to village within the same ward.

The distance from villages to permanent and temporary water sources was measured from compiled maps. The average distance from villages to the nearest permanent water bodies was 2.0km (SD 1.6km) while the distance to temporary water bodies was 0.55km (SD 0.30km).

The distribution of schistosomiasis in Bushu also varied from village to village and the general distribution as shown from the reagent strip results for *S. haematobium* and parasitology for *S. mansoni* are shown in Figures 3.3 & 3.4. Also shown is the distribution of *S. haematobium* in the 10–12 year age group. Schistosomiasis is most prevalent in central Bushu where most dams are found.

The average distance of villages in Bushu to temporary water bodies was 0.48km (SD 0.28km) while the average distance to permanent water bodies was 2.73km (SD 1.93km).

There was a significant relationship between the distance from permanent and temporary rivers and the prevalence of *S. haematobium* diagnosed for Madziwa by parasitology ($P<0.05$). For Bushu there was a significant relationship between the prevalence of reagent strip *S. haematobium* and the distance to permanent rivers ($P>0.01$) for all age groups combined as well as for the 10–12 year age group.

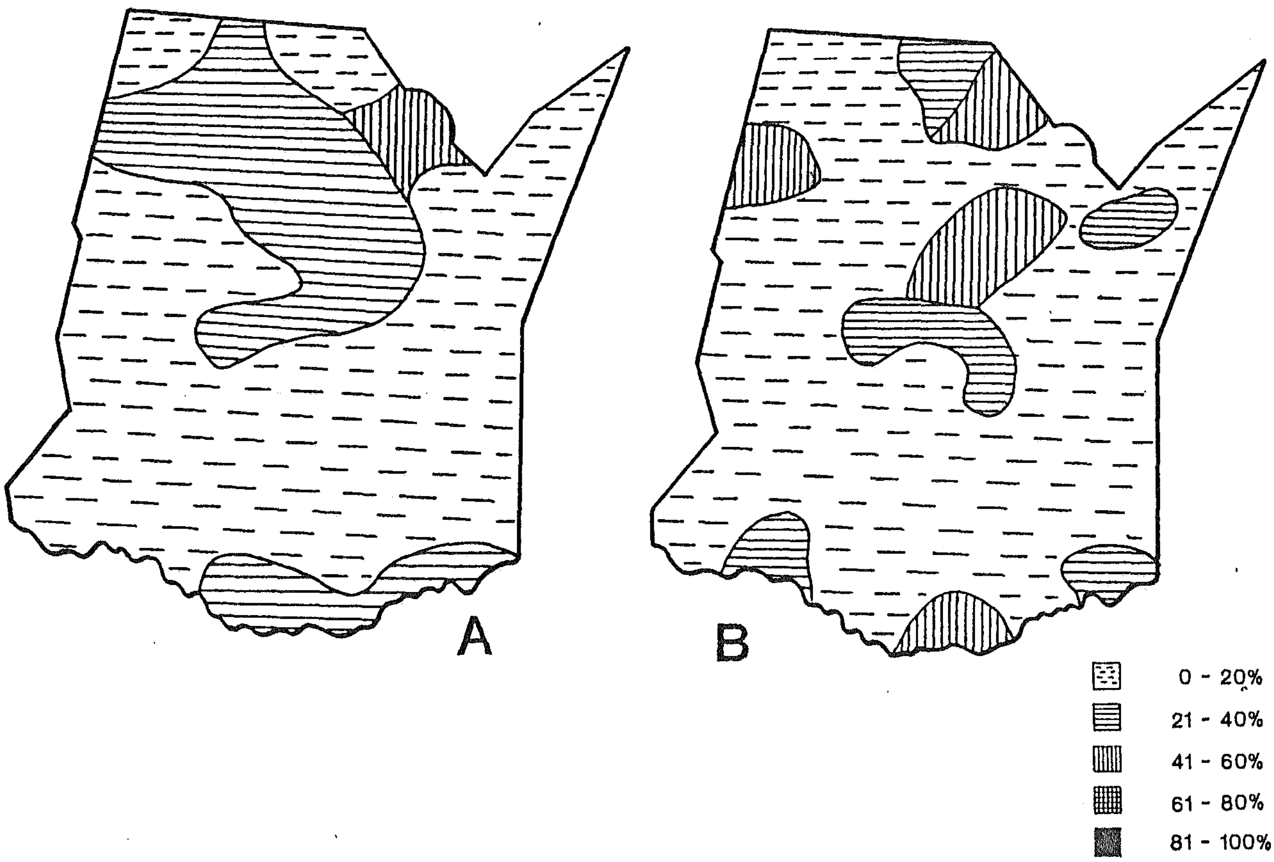


Figure 3.2: Preintervention distribution of *S. mansoni* by village in Madziwa. As determined from Jan/Feb 1986 reagent strip examination of urines from school children; A. all age groups, B. 10–12yr age group.

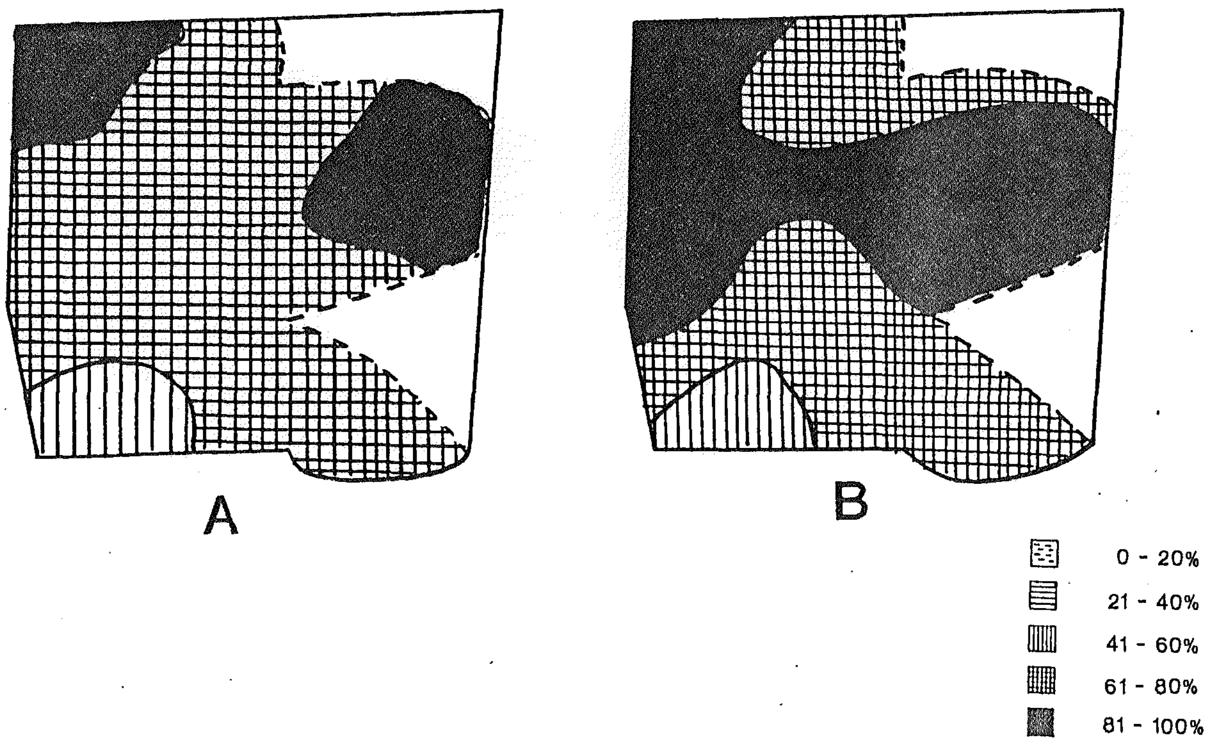


Figure 3.3: Preintervention distribution of *S. haematobium* by village in Bushu. As determined from Jan/Feb 1986 reagent strip examination of urines from school children; A. all age groups, B. 10–12yr age group.

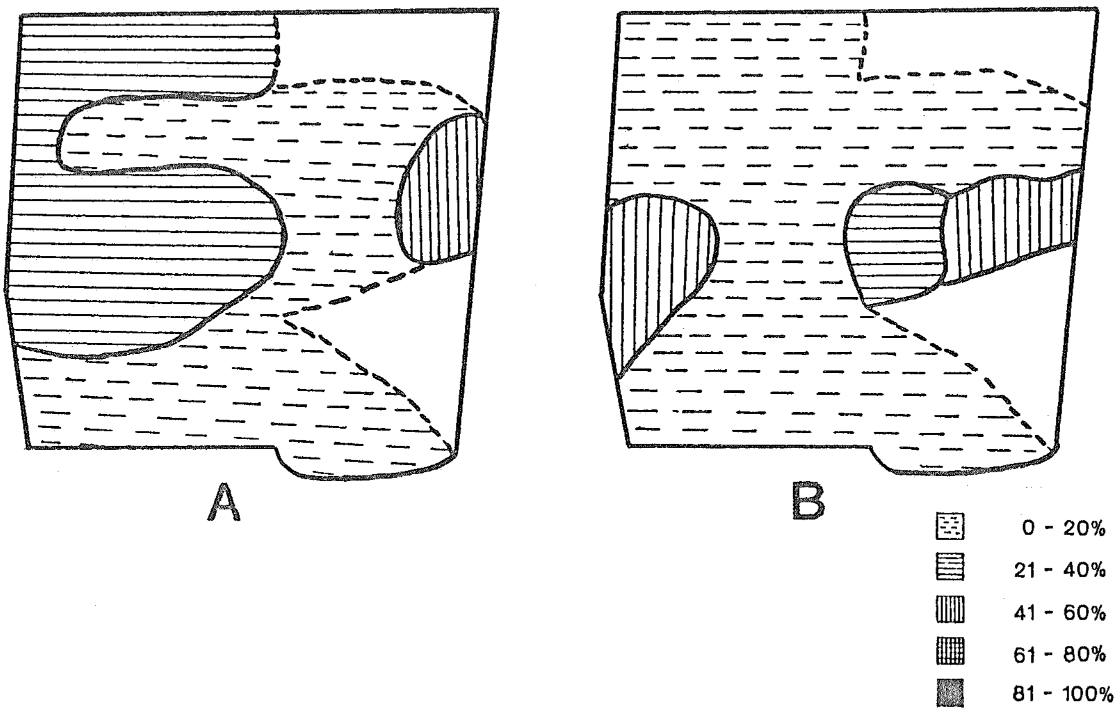


Figure 3.4: Preintervention distribution of *S. mansoni* by village in Bushu. As determined from Jan/Feb 1986 reagent strip examination of urines from school children; A. all age groups, B. 10–12yr age group.

3.1.1 Discussion.

The transmission of human schistosomiasis is a complex biological process governed by a range of interacting ecological factors. These factors are determined by local geographical and climatic conditions and by the behaviour of the definitive hosts. Climatic factors which are important in transmission are temperature and rainfall. Differences in the environmental and climatic conditions may produce effects such as desiccation, flooding or cold which affect snail populations and the frequency of human contact (Taylor & Makura, 1985).

The distribution of schistosomiasis in both Madziwa and Bushu was focal and may be related primarily to water permanence and accessibility. Communities living in close proximity to permanent water bodies are expected to have higher prevalences of schistosomiasis than surrounding villages not so exposed (Gryseels & Nkulikyinka, 1988; Taylor & Makura, 1985) and it is important to note the significant relationship observed between distance to permanent water and the prevalence of schistosomiasis found for the present study.

The major water bodies in Madziwa are Mufurudzi river and Eben Dam to the south, Mupfure river to the north and Kakovakomugano to the east with many others smaller (Figure 2.1). The major river in Bushu is Zvirugurira which cuts across wards 10 and 11 (Figure 2.2). Villages with prevalences of over 80% of *S. haematobium* diagnosed by parasitology were found in most Wards.

The distribution of *S. mansoni* also illustrated focal transmission. High prevalences of over 50% were found in ward 7 in the same villages where highest prevalences of S haematobium were obtained for all age groups (Figures 3.1 & 3.2). High prevalences of *S. mansoni* were also observed more frequently in the 10–12 year age group.

The distribution of schistosomiasis in schools provides an overview of the size of the problem in the general area since school children come from different catchment areas and may have a number of rivers to cross to and from school.

In summary it can be seen that schistosomiasis was a major problem in terms of prevalence in both Madziwa and Bushu at the beginning of the study.

3.2 SANITATION PROGRAMME.

3.2.1 Training programmes.

At the beginning of the intervention programme several groups of builders were trained. These people were selected from the wards throughout the Madziwa study area and training on latrine construction was conducted at nearby schools. The trainees built demonstration latrines, were given some theoretical background and were provided with some simple instructional material. At meetings between representatives of the builders, the District Council and Village Community Health workers a price for latrine construction was agreed. There was one refresher course for some of the builders and late in the implementation a competition was held for the builders who had constructed the best, and most, latrines.

3.2.2 Operational aspects.

There were a large number of operational problems which are probably common to all such community based programmes but which are also often ignored as they are mainly solved at the operational level. It was clear that the use of local health personnel as managers was important because of their knowledge of locally important channels of communication. The District Council's support for the programme was good but the councillors were largely ineffective in transmitting this support back to the community. The most effective meetings were with ward and village committees and the most effective way of disseminating information about the programme was through the VCW's.

As the community was responsible for the largest part of the expenditure on the latrine it was clearly not possible to coerce the family into construction but the frequency of follow up was a very important indicator to the family that action was expected. The seasonal availability of locally made bricks and the seasonal money supply following harvest not to mention the periodic non availability of cement all played roles in slowing the implementation.

The trained builders from the first training sessions found more lucrative employment building latrines outside the study area in the commercial farms. Other newly trained builders tried to charge too much money causing a resistance in the population to employing them. A standard rate was adopted at a meeting between the builders and the VCW's. However as more money was paid for the double compartment latrine, and in many cases families wanted separate male and female latrines, most latrines being built were the double version. This meant that the cement subsidy was inadequate and families had to supplement their free issue with a couple of extra pockets of cement. As a result of this the most common problem in construction was that cement was finished before the casting of a slab for the roof. Many latrines therefore remained unfinished for some time awaiting a roof although they were usually put into use by the family.

It became apparent early on that individual families were ready and waiting for cement and that the programme was being held up by waiting for several families to be ready in one area. It was then agreed that families could come with their VCW to certify that they were ready to construct and the cement would be issued from the storage depot in town. This cut down project mileage and allowed the whole communal land to be covered more effectively.

The rate of construction can been seen from Figure 3.5. The national shortage of cement caused the flat periods shown in Figure 3.5 and resulted in the extension of the implementation period from two to three years. The target of 3000 latrines was not reached in terms of individual structures (2455, 81.8%) but as 53.4% of these were double latrines it was more than reached in terms of facilities (Table 3.2).

At the time of compilation only 88.5% had been completed and the reasons for non completion are given below. As mentioned earlier, the amount of follow up was important as a motivating factor to the villager and to correct bad construction early. Unfortunately as the programme began to speed up and building

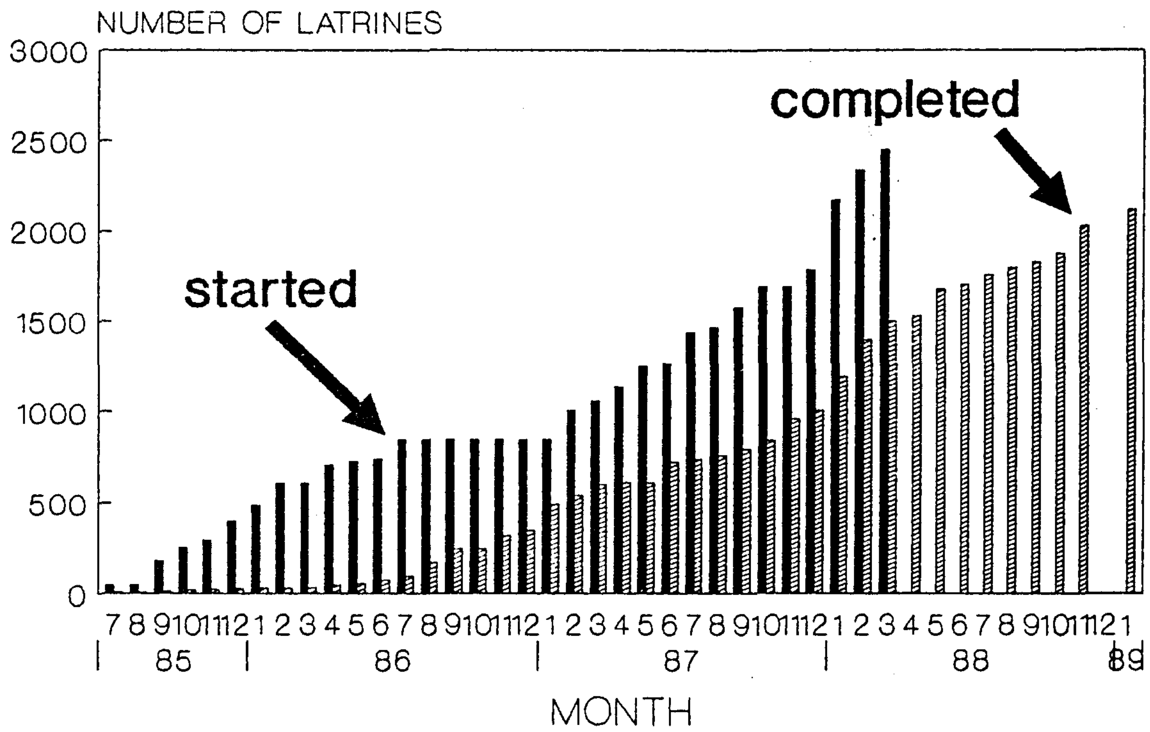


Figure 3.5: Cumulative number of families in Madziwa issued with cement for latrine construction and the number completed.

Table 3.2: The number and type of completed and incomplete Blair latrines in Madziwa from 2455 households issued with cement for building.

TYPE	COMPLETED		INCOMPLETE	
Single	887	(41.2%)	0	
Double	1017	(47.3%)	0	
Unspecified	248	(11.5%)	30	
TOTAL	2152	(87.7%)	303	(12.3%)

Table 3.3: The distribution of completed Blair latrines by Ward.

WARD	NUMBER OF BLAIR LATRINES
1	230
2	274
3	325
4	209
5	235
6	233
7	312
8	153
9	181
TOTAL	2152

was going on throughout the area it became impossible for the limited number of project and health staff to cover the area more often than about once every two months. Although some mistakes were made in construction it is believed that as more experience was gained by the builders and the villagers, the standard of construction improved considerably. The distribution of latrines by Ward is shown in Table 3.3.

3.2.3 Quality of Construction.

A survey was conducted to assess the quality of the Blair latrines built in the study area. Seventy (70) randomly selected latrines were selected for the study using the framework of the Knowledge Attitudes and Practices survey. These latrines were judged in relation to the recommendations on construction given to builders and the suitability of the construction for its purpose.

On entering the latrine a subjective assessment was made of how well it was ventilated and 38.6% were considered to be poorly ventilated. Likewise fly breeding was assessed subjectively and on analysis gave a significant ($P<0.05$) relationship with poor ventilation.

The recommended pit depth for the Blair latrine is 3 metres. The average pit depth of Blair latrines examined was 2.46 metres, ranging from 1.5 - 4m.

Most of the latrines were considered to be well sited in that they were downhill from wells, facing into the wind and clear of trees. The average distance of the latrines from the nearest dwelling was 30m which probably has a significant influence on the use of the latrine by small children, especially at night (see KAP 3.5).

Of the 42 double compartment latrines 6 did not have the pit properly divided and therefore were unlikely to be properly ventilated. In this respect it was found that they were among the poorly ventilated latrines. Most pits were lined with bricks (88.7%). Although in some areas of Madziwa the ground is firm enough that lining may not be necessary this is always an encouraged practice.

The recommended floor slab thickness of 7.5cm allows a large safety margin.

37.8% of slabs were below 5cm but there had been no evidence of any construction failure in any of these slabs which are reinforced with 3mm wire.

All the sampled latrines had vent pipes. For best ventilation it is recommended that the vent pipe extend at least 40cm above the roof (Ryan & Mara, 1983). Seven (11.9%) of pipes were less than 30cm above roof level and these latrines were significantly less well ventilated ($P<0.05$) than those with taller vent pipes.

The vent pipes were of adequate dimensions for ventilation with a mean of 32.9cm (SD 10.6) inside diameter. Of concern in relation to fly control was the lack of a fly screen on the vent pipe of 21.7% of latrines although it was not possible to show any relationship between lack of fly screen and amount of fly breeding.

The recommended minimum distance from the squat hole to the nearest wall is 20cm which was usually complied with, however 4 (5.7%) were 10cm or less. The width of the entrance of the Blair latrines is recommended as 60cm and although most latrines conformed to this it was also not unusual to find entrances made too narrow or too low. Five (7.1%) had an entrance of only 30–40cm wide and four (5.7%) had entrances of 140–160cm high.

For ease of cleaning and general latrine hygiene it is recommended that the floor should be sloped towards the squat hole. This was only found to have been done for 52.1% of the latrines. Roofs were constructed from cement (64.7%) as well as wood, thatch, and asbestos sheets. There were no structural defects on 80% of the Blair latrines and usually the defects were cracking of walls. Walls were plastered in 80% of the latrines.

Discussion.

Considering the difficulty in supervising building operations scattered throughout Madziwa the latrine construction has been of a very high standard. Most of the problems of construction were observed in the early stages of the programme as already mentioned and as the builders gained experience the numbers of errors greatly decreased. None of the errors made the latrine unusable and presumably such mistakes would have been corrected by the builder at the time. The effectiveness and life of the latrine would have been adversely affected by the lack of pit lining and the use of shallow pits in some cases.

As expected, latrines with odour problems were associated with incorrect construction - either of the vent pipe or lack of a partition in the double latrine. That all of the latrines were functioning and being used was evidenced by the Knowledge Attitudes and Practices study.

The tendency to place latrines a long way from the dwelling is the historical association between the latrine, odours and flies. It is likely that as the VIP latrine is more commonly used it will be constructed closer to the home in recognition of the reduced fly and odour problem.

Table 3.4: Economic status of adopters and non adopters. The percentage of households conforming with the measure of economic status.

MEASURES OF ECONOMIC STATUS	Adopters N=86	Non adopters N=84
Households without cattle	22.6	41.9
Households with >16 cattle	10.7	2.3
Farming on >4 acres of land	50.0	32.6
No farming in previous year	14.0	39.5
>3 brick dwellings	48.0	25.6

3.2.4 Adoption Survey.

Factors influencing the adoption and non-adoption of the offered sanitation programme in Madziwa were studied by the administration of questionnaires to 86 families with a VIP latrine (adopters) and 84 families without a VIP latrine (non adopters). In all, 170 questionnaires were completed.

It was found that there was a significant relationship between the size of the family and the presence of a latrine. More adopters (60.7%) than non adopters (44.3%) had over 4 children (under 15 years). It was also observed that 29.8% of adopters had more than 5 huts while only 14.0% of non adopters had over 5 huts in the homestead. Economic status was also found to be an important factor with wealthier families being most likely to take advantage of the free issue of cement (Table 3.4). There was no correlation between religion and the presence of a latrine although believers in the Apostolic faith do not allow members to seek medical attention for any diseases.

When adopters were asked why they constructed latrines, they gave the following reasons: prevention of diseases (45%), privacy (19%), cleanliness (23%) and convenience (13%). The completed latrine was always being used by some members of the family although very young children may not always use it for fear of the hole and sometimes it was culturally unacceptable for some members of the extended family to use the same latrine.

Of the non adopters 90.7% were aware of the sanitation programme with the Village Community Workers being the main source of information for 67.9% of adopters and 57.0% of non adopters. Other sources of information were the Village Development Committees and Environmental Health Technicians.

Most non adopters (90.7%) were willing to build a latrine and most of them (93%) passed excreta in the bush. Problems which hindered the construction of latrines were lack of labour (28%), lack of money (12.8%), lack of bricks and the uncertainty of being moved for resettlement (36.0%) and other priorities such as work and farming (11.6%).

When the adopters were asked whether they would have built the latrine if the cement was not provided, 78.3% said that they would. 31.0% had already encouraged neighbours to build a latrine while 48.8% intended to do so.

For both adopters (65.6%) and non adopters (61.6%) a clean water supply was expressed as the greatest felt need. Other priority needs included food (due to a current drought), farming implements and roads. In Bushu 30% of non adopters responded that availability of cement was a problem whereas this was not mentioned in Madziwa.

Discussion.

Considerable experience was gained of the problems associated with community motivation and the use of various channels to disseminate information in rural areas. It is clear that much depends upon the motivation of staff at District level who are vital to proper implementation and who are best able to respond to the many and varied issues which continuously arise.

The link between economic status and adoption of the latrine construction programme could be due to several reasons such as a better responsiveness to health education issues as well as being better able to afford the family contribution to latrine construction costs.

The size of the family also influenced the process of adoption. Those families with more than 4 children or more than 4 huts were more likely to build latrines. Large families are more likely to recognise the need for privacy and adequate sanitation than smaller ones in a similar way that crowded communities recognise the need for sanitation.

For maximum impact on health and schistosomiasis transmission every family should have adequate sanitation facilities. Thus it may be necessary in the planning stage of a sanitation programme to assess the economic status of the target population to identify groups requiring additional help or motivation.

It was found that 48.8% of adopters had encouraged their neighbours to construct latrines and that 31% intended to. It was observed therefore that communities were aware of benefits of the latrine programme and were willing to motivate others to achieve the same benefits. The VCW's clearly play a very important role and provide the most successful channel for information dissemination at the village level.

The expressed need for improved water supplies is relevant to the water sector of the programme and indicated that the community is open to inputs related to improving their access to, and proper utilisation of, safe water. This is an important adjunct to sanitation for schistosomiasis control.

The observed benefits of the latrines given by adopters and the reasons given by non adopters for not building latrines are rationalisations which, although important in themselves, probably only reflect a natural process in the adoption of any new technology. It is to be expected that the innovators in a society are more open minded and prepared to try something new; others will rapidly join an apparently successful venture; whilst a few will remain sceptical for a long time. It is believed that in Madziwa the majority now have latrines or have been convinced of the social advantages enjoyed by those with latrines. It will therefore only be a matter of time before the remaining families submit to the socially accepted 'norm' of having a VIP latrine.

3.3 WATER PROGRAMME.

3.3.1 Implementation.

The initial approach to the water programme fully involved the community in the use of a hand operated drilling rig which they used to dig shallow wells in sites selected by themselves. If the site proved to be dry or they encountered difficulties with rocks they would move the rig and drill again. This approach had the advantage of complete community control over the project and the amount of community support was impressive. A hole could be drilled in two or three days and then the rig would be moved on to the next village.

Unfortunately this programme was not as successful as originally hoped due to the rocky nature of the ground in much of Madziwa and the use of the rig was gradually discontinued in favour of protecting existing wells.

The shift onto the protection of existing wells meant that the programme moved a bit faster however constraints still lay with the time taken for community motivation and discussion. From 1987 the District Development Fund (DDF) became responsible for small water supplies at community level and so actively participated in training programmes, pump installations and construction of headworks. DDF assisted the community with construction of headworks at all boreholes in Madziwa which up until this time had been largely unprotected.

In all of these exercises the aim was to enlist community support where possible. The community provided labour in the protection of the wells and the construction of alternative laundry facilities (washing slabs) and they provided the bricks and river sand for the building of these facilities. The target was for 150 hand pumps to be installed in Madziwa, or approximately 18 per Ward. Each borehole was to have a washing slab. To date there are 104 shallow wells that have been protected and fitted with Blair pumps, 43 of 44 boreholes have washing slabs and several bucket pumps have been fitted on protected wells. The coverage with hand pumps was not as good in some areas due mainly to a lack of suitable sites but also to some extent to a lack of community support. The distribution of water points in Madziwa and Bushu is shown in Figures 2.1 & 2.2 and Table 3.5.

During the implementation of the water programme, a number of problems were encountered in addition to those mentioned above. Due to poor site selection some of the wells identified for protection and installation of hand pumps were not perennial and would dry up in the dry season. Community participation was difficult to motivate in certain areas. The protection of existing wells was done only after consultation with the local community and the agreement of a water committee selected by the community. However on some occasions where the well was actually inside a persons land a dispute would arise between individuals and the community may be denied access to the water point. The major problem, however, was related to maintenance and this is discussed below.

Table 3.5: The distribution of Blair pumps installed by Ward in Madziwa.

WARD	NUMBER OF BLAIR PUMPS
1	20
2	10
3	7
4	24
5	14
6	11
7	2
8	5
9	11
TOTAL	104

3.3.2 Operation and Maintenance.

For operation and maintenance the MoH with DDF and a Local Government Promotion Officer would assist the community in setting up a water subcommittee to be responsible for maintenance and repair of the installed Blair pumps and the other protected water points in the area. This subcommittee would also keep records of parts broken and replaced. The parts would be available from the DDF store on request of the water committee. The water committees were trained on several occasions on the installation and repair of Blair hand pumps and on the preventive maintenance of headworks and borehole 'bush pumps'.

The training sessions were very successful and the committees by and large were quite capable and competent in their work. The DDF agreed to stock spare parts for the Blair pumps and some improvements were made in their stores.

Nationally Zimbabwe has adopted a three tier maintenance system of water committees at village level, a pump minder to oversee repairs of several pumps and DDF for major repairs. Unfortunately no pump minders have been employed in Madziwa and therefore the village water committees have no support. Their interest is therefore not sustained and several pumps have been found broken and not reported. There may also still be a problem of communities not recognising the installed pumps as theirs as the system still allows for full government control. These are major issues affecting the water programme as a whole in Zimbabwe as well as Madziwa and they remain to be resolved for the efficient maintenance of sustainable water supplies in rural areas.

3.3.3 Water Use Survey.

The survey was carried out at boreholes fitted with a bush pump, shallow wells fitted with a Blair pump and at human water contact sites on natural water bodies. The number of users at each type of water source between 0730-1030 hours is shown in Table 3.6.

The average delivery rate of the sampled Blair pumps was 20.6 l/minute while that of the bush pumps was 17 l/minute. At the time of the survey (May), water

Table 3.6: The total number of users coming to visit Blair pumps, Bush pumps and natural water sites by time of day.

TIME	BUSH PUMP (n=15)	BLAIR PUMP (n=15)	NATURAL WATER BODY (n=13)
0730-0800	41	24	17
0801-0830	34	21	9
0831-0900	44	7	6
0901-0930	31	29	8
0931-1000	20	21	10
1001-1030	26	19	26
TOTAL	196	121	76

Table 3.7: Percentage of users collecting water for use at the site and the purpose.

SOURCE	PURPOSE				TOTAL (%)
	Washing clothes	bathing	gardening	Washing utensils	
Bush Pump	4	1	0	1	6(4.8%)
Blair Pump	1	2	1	0	4(5.9%)
Natural Site	7	1	7	1	16(66.7%)

was abundant at the natural water sites. In each half hour period up to five users were administered the questionnaire on water use and the total number of questionnaires administered was 126 at the bush pump, 68 Blair pump and 24 at the natural water body.

Users were collecting water for various purposes and were either using the water at the site or were taking it away for use at home (Tables 3.7 & 3.8).

Those people using the water at the supply point were mainly using it for washing clothes and bathing. Gardening was a significant activity at natural water bodies but only one person was using water from a pump (Blair) for gardening at the site and one person from the bush pump was taking water for the home garden (Table 3.8).

The majority of the users collected water for use at home for various activities. Table 3.8 shows the purpose for which the water was collected by those who only collected water for use at home.

Twelve (80%) of the 15 bush pumps visited had both washing slabs and cattle troughs, 2 bush pumps (13.3%) had cattle troughs only and 1 (6.7%) had no facilities. None of the 15 Blair pumps or the 13 natural water sites had washing slabs or cattle troughs.

The users were asked where they collected water before the protected water sources were installed. In some cases the present facility had always been there or the respondents usually use more than one site. The majority of users (60–75%) used natural water bodies or unprotected wells before the present facilities had been constructed.

The users were asked which water source they used for washing clothes (Table

Table 3.8: The purpose for which water was collected for use at home and the percentage of users taking the water home.

Source	PURPOSE					TOTAL
	Washing utensils	Bathing	Cooking	Gardening	Washing clothes	
Bush pump	7	5	105	1	2	120 (95.2%)
Blair pump	6	4	50	0	4	64 (94.1%)
Natural site	0	0	8	0	0	8 (33.3%)

Table 3.9: The sites which the users at bush pumps, Blair pumps and natural sites used for washing clothes. (* this site = washing slab as most boreholes have washing slabs.)

WATER SOURCE	SITES FOR WASHING CLOTHES					
	this site	washing slab	natural site	home	unprotected well	tap
Bush pump	*	67 53.6%	52 41.6%	4 3.2%	2 1.6%	0 0%
Blair pump	12 17.6%	2 2.9%	41 60.3%	11 16.2%	2 2.9%	0 0%
Natural site	10 41.7%	0 0%	10 41.7%	0 0%	0 0%	4 16.7%

3.9). Forty one percent of borehole users, 60% of Blair pump users and 83% of natural water body users do their washing in natural water bodies thus increasing the risk of contracting schistosomiasis. Boreholes with washing slabs and Blair pumps had a big impact on water contact behaviour as prior to their construction the majority of users had been performing washing activities at natural water bodies (71%) or unprotected wells (11%).

When asked about alternative water sources the convenience of handpumps was evident as 91.2% of Blair pump users and 76.1% of borehole users said they did not use any other water source. There was some conflict in the data here as other questions elicited that up to 50% of them used natural water bodies for washing of clothes.

The users were asked what they liked about the particular water point they were using and for the hand pumps the clean water and convenience were the most important factors (Table 3.10). Users of natural water bodies were most interested in the large volume of water.

When asked if there were any additional facilities they wanted to be added to the sites the users of natural water bodies did not see this as a relevant question. Blair pump users wanted washing slabs (58%) or nothing (34.5%) and bush pump

Table 3.10: Why users prefer specific water points.

PRESENT WATER SOURCE	PREFERENCES				
	clean water	closest	facilities	more water	better taste
Bush pump	71 66.4%	31 29.0%	1 0.9%	2 1.9%	1 0.9%
Blair pump	48 70.6%	18 26.5%	0 0%	2 2.9%	0 0%
Natural water	10 43.5%	4 17.4%	2 8.7%	7 30.4%	0 0%

users wanted nothing extra (47.3%) or additional washing slabs (26%). There was very little demand for latrines or bathing shelters.

When questioned on the likes and dislikes of the facilities almost 50% of pump users did not like the dirty conditions at the water point although there were no other significant dislikes. At the natural water body the lack of privacy was raised as a dislike (41.7%) in addition to the dirty conditions (41.7%).

Discussion.

The impact of the water programme in the area has been demonstrated because the users have left their original sources of water for the provided Blair and bush pumps. The original sources of water for people using the Blair and the bush pumps were natural water sites and unprotected wells.

The greatest number of people came to draw water between 0730–0800 hours and women were the main water drawers. The collection of water in the early morning leaves time for other chores and it is seen that the washing of clothes at natural water bodies increases later in the morning. It was found that although Blair pumps draw more water per minute than bush pumps, more people visited bush pumps than Blair pumps which probably is a reflection of the smaller target population to be served by the Blair pump which is less robust. There were very few people visiting the natural water sites although water was abundant at the time the survey was carried out in May. It was clear that natural water sites are still largely used because of the large volumes of water available for the washing of clothes.

The use of water for gardening is rare at pumps. To reduce schistosomiasis transmission as well as stream bank erosion it would be useful to encourage the use of water from pumps to establish nearby gardens. However as this activity has not been established from users initiative there may be some constraints such as limitation of water or social disapproval which need to be investigated before such a programme can be initiated.

Except for the washing of clothes by 50% of pump users, 79.2% of the users at bush pumps and 91.2% of users at Blair pumps did not use alternative sources of water. This highlights the importance of pumps in the area being able to modify water contact behaviour. The provision of washing slabs to the sites with Blair pumps, could also reduce contact with unprotected water even further. As women tend to take their young children with them when washing clothes any transfer of this activity away from natural water bodies to washing slabs could have a marked benefit in reducing schistosomiasis transmission.

The two main reasons given in preference of the regular sources were the presence of clean water and closeness to households. This is very important but it is also important to increase the amount of water available at these pumps to attract people away from rivers where the stated main attraction was the abundance of water. Water abundance from pumps can be increased other than through the use of more efficient pumps. The installation of more pumps will reduce waiting time and closeness to home will reduce walking time. Both of these actions effectively increase water availability. The main unfavourable aspect of the bush pumps and Blair pumps was that they were dirty. This can however be corrected by organising the users to clean the sites from time to time.

It was evident from the survey that Blair and bush pumps with associated facilities can meet the water related demands of the community and increased coverage could further favourably change the water contact behaviour of the population. Blair pumps are easy to install, inexpensive and therefore a great number can be installed in a rural community. The installation of washing slabs at all pumps has to be considered for them to be fully effective in reducing other water contact behaviour. In relation to the transmission of schistosomiasis it is clear that washing at natural water bodies is the most important activity to be considered in future intervention programmes.

This behaviour study has not considered operation and maintenance issues which are crucial in any water supply programme. This first stage of the schistosomiasis control project was one of implementation and the operation and maintenance system set up as described earlier in the report will be evaluated in the next phase of the study at Madziwa.

3.4 HEALTH EDUCATION

This was recognised at the beginning as being probably the most difficult component of the project and this turned out to be the case during the project.

At the outset it was felt that health education should remain part of the normal health service activity and be implemented through the office of the Provincial Medical Director. Unfortunately the trained health education officers at that level lacked access to adequate transport to be able to support the staff in the field.

Films on bilharzia, hygiene and clean water were available in the area and were shown to schools and womens groups in the first year of the project. In addition general informative talks were given to gatherings of influential members of the society whenever possible. An important development was the availability of simple instructional guidelines on latrine construction and maintenance (Figure 3.6) to support the builders being trained and the families building their own

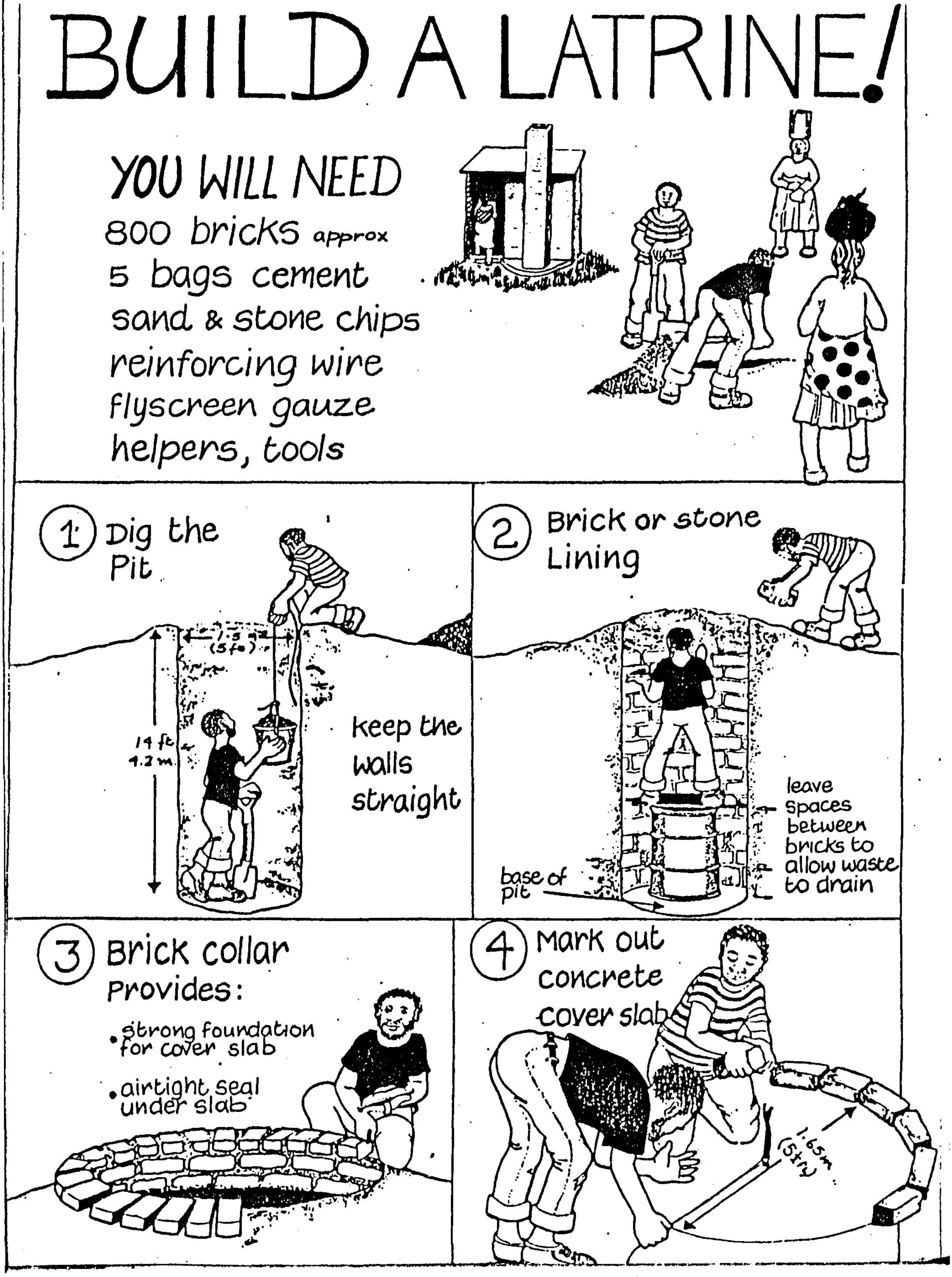


Figure 3.6: Example of simple instructional material for builders

latrines. Some of this information was enclosed in plastic for durability before being supplied to the community.

This information exchange was carried out by health personnel based in the District. As part of the initial introduction to the programme and for ongoing communication and planning issues there were regular meetings with village and Ward committees as well as the District Council.

It became apparent that the majority of the adult population could not easily be reached. Due to the limited time and commitment to other duties, health staff could not spend the necessary amount of time addressing the community and gatherings of adults from village level took a considerable amount of organisation. After the first year education activities therefore tended to focus largely on school children with the remainder of the community given health education as an adjunct to other business at meetings.

Schools continued to receive health education in conjunction with the chemotherapy programme but a major initiative was the introduction of an annual drama competition held from 1986.

Drama is recognised as an effective form of communication which is an important part of local culture. It has been used successfully in other programmes in Zimbabwe and allows the community to become fully involved in its own education process. All of the schools in Madziwa were invited to compete in producing plays on a schistosomiasis or water and sanitation related topic. Educational material was provided on request and support on technical provided to schools. Competition rules were drawn up and circulated with the final competition to be held on World health day each year.

Plays were performed before the school and before parents when they were judged by a team of health workers. A group of five finalists were selected to perform their plays at the final competition at the community hall in Madziwa Centre. Officials from Health, Local Government and Education were present and participated in the speeches as well as the prize giving. The Education officer was so impressed by the first performance that he requested it be done annually with the full support of his Ministry.

3.4.1 Health Education Evaluation.

The health education programme, as described above, was limited in coverage and activities. The KAP surveys of 1985 and 1988 (see below) showed a very limited impact of the programme on the knowledge of the adult female heads of household about the disease schistosomiasis. As the education programme was most likely to have had an impact on the school children, a post intervention evaluation was undertaken as described in the methodology.

The children in the survey were all attending grade seven classes and were aged between 12 and 15yrs. The questionnaires were administered to 184 children from Madziwa schools, 132 from Bushu and 154 from Mount Darwin. In general all children demonstrated a relatively poor knowledge of schistosomiasis. There was no significant difference between the three areas in the mean score for the

Table 3.11: The understanding of different aspects of the schistosomiasis life cycle by school children in Madziwa, Bushu and Mount Darwin. Percentage correct responses.

QUESTION	MADZIWA	BUSHU	Mt DARWIN
The primary host is man.	100.0	100.0	100.0
Excreta disposal plays a major role in transmission	65.0	58.0	38.0
For transmission to occur Schistosoma eggs must reach water	74.0	73.0	51.0
Unprotected water is a major source of infection	91.0	89.0	40.0
Snails are the secondary hosts	29.0	27.0	14.0
Ability to co-ordinate life cycle facts	25.0	14.0	5.0

multiple choice questions although the Madziwa children performed better than the children from the other two areas.

The children could relate safe water and schistosomiasis satisfactorily although there was no significant difference between the schools (Madziwa 85.7%, Bushu 74.6%, Mount Darwin 85.2%). On the question of the importance of using latrines as a means of reducing schistosomiasis, children from Madziwa averaged 45% while children from Bushu and Mount Darwin averaged 37.5% and 30.5% respectively.

The children's knowledge on specific aspects of the life cycle of schistosomiasis was poor overall. When asked to to illustrate pictorially the life cycle the children from Madziwa, Bushu and Mount Darwin averaged 38.3%, 36.8% and 26.8% respectively. When their response on the life cycle was analysed in detail it showed clearly that the children in Madziwa had a consistently better knowledge of the schistosomiasis than Bushu and a significantly better knowledge than Mount Darwin children (Table 3.11). The basic weakness amongst all of the children was the lack of much ability to coordinate this information.

3.4.2 Discussion.

Considering that there was a very active schistosomiasis control programme in Madziwa, it was expected that the school children there would perform better than their counterparts in Bushu and Mount Darwin. However the performance of the children in the evaluation of health education highlighted a number of issues.

Children did not grasp the details of the disease in terms of the technical name of any of the stages and as has been found by Laver (1977) this is not necessary and an undue emphasis on this may actually retard the understanding of the life cycle. The majority of the children from the three areas were aware that unprotected water was the source of schistosomiasis transmission. Poor performances were recorded in the questions related to the schistosomiasis life cycle. Although the children from Madziwa performed better than those from Bushu and Mount Darwin it was evident that the life cycle was not clearly understood.

Health education in schistosomiasis should place more emphasis on the relationship between components of the life cycle as this is fundamental to an understanding of methods of prevention of transmission. Health education campaigns targeted towards school children have been shown to to be very successful when implemented in the school environment. Celestin (1977) as well as Dwivedi et al, (1973) found that the knowledge of children in schools where the teachers had received training courses on the transmission of water related diseases improve significantly compared to children in schools where no such intervention occurred. It has previously been shown in Zimbabwe (Laver, 1977) that school teachers misconceptions are strongly reflected in the performance of the students. It is recommended therefore that disease control, through health education inputs, should make use of the existing infrastructure provided by schools, clubs and hospitals but the instructors themselves need also to be a specific target for the education messages.

3.5 KNOWLEDGE, ATTITUDES AND PRACTICES

3.5.1 Pre-intervention survey.

A total of 349 questionnaires were completed for the first survey in 1985.

Sanitation.

No latrines were present in 61% of HH and only 6.3% were in the process of building one. Of the remaining 32.7% of HH most had a normal pit latrine and 16.7% (5.4% of HH sampled) had some kind of ventilated improved pit latrine (VIP). All householders with latrines said that they used the latrine. Separate latrines for males and females were found in 38.6% of those HH with latrines. The only significant non-users of latrines were infants (9.6%) with the main reasons given as the fear of falling down the hole and the distance of the latrine from the home. The latrine was also used as a washroom by 14.3% of HH. A higher proportion of the HH with a VIP latrine used the latrine as a washroom (33.3%) than HH with a pit latrine (11.2%) although the difference was not significant (P=0.072).

Householders with latrines were asked what they liked and did not like about their latrine. The most appreciated benefit of having a latrine was given as less disease (63.2%) privacy (21.9%) and few flies (11.4%). Only 34% of HH with latrines offered information on what they did not like about the latrine and of these 56.4% disliked the smell and 23.1% the flies, with a flooding hazard during the rains and distance being minor dislikes. There was no correlation between the type of latrine and what the HH saw as the good or the bad features of the latrine.

Table 3.12: Source of drinking water for Madziwa and Bushu families.

Source	house. tap	communal tap	protect. well	unprot. well	bore hole	river	dam
number	11	29	22	177	69	33	7
percent	3.2	8.3	6.3	50.9	19.8	9.5	2.0

Table 3.13: Sites used for the washing of clothes in Madziwa and Bushu.

Source	house. tap	communal tap	protect. well	unprot. well	bore hole	river	dam	home
number	1	21	4	42	10	224	23	24
percent	0.3	6.0	1.1	12.0	2.9	64.2	6.6	6.9

With regard to the VIP latrines the number of respondents was too low for any statistical analysis.

Of the HH without a latrine, or in the process of building one, all of them passed urine and stool in the surrounding vegetation with the exception of one who used a communal facility.They also overwhelmingly wanted a latrine (97.4%) giving such reasons as less disease (48.5%), cleanliness (23.8%), increased privacy (21.3%) and that it would be close to the home (3.8%). The six HH who did not want a latrine found them expensive (4) had no labour (1) or were about to move (1).

Water supplies.

Drinking water was usually obtained from an unprotected well or a borehole (Table 3.12) and together the sites of drinking water collection which were considered to pose no risk of schistosomiasis transmission made up 88.5% of drinking water sources.

Washing of clothes was normally carried out at a different site than that used for the collection of drinking water (Table 3.13). Water sources which pose a threat of schistosomiasis transmission make up 70.8% of sites where washing activities take place (Table 3.13).

Sources of water for the home were usually within 1km radius (87.1%) and 58.1% were within 500m of the home. Water was collected for the home two (43.8%) or three (36.4%) times a day. There was no correlation between the frequency of water collection and the distance from the home.

The quality of water was clearly an issue and 99.7% of HH thought that the best water came from a protected well a borehole or a tap. Only 9.2% of HH said that they boiled drinking water however of the HH who obtained their drinking water from a dam 28% boiled the water.

Table 3.14: Correlation between the householders knowledge of the symptoms of schistosomiasis and belief that members of the family are infected.

	INFECTION BELIEF		
SYMPTOMS	infected	uninfected	Total
urinary blood	134	112	246
tiredness	2	17	19
weight loss	10	14	24
Total	146	143	289

Schistosomiasis.

When asked about the presence of schistosomiasis in the family 43.8% of HH thought that no one had the disease and 13.2% did not know. 37% of HH thought that the children had schistosomiasis whilst a further 3.2% said that both adults and children had the disease. Schistosomiasis was not recognised as a problem amongst adults where only 6% of HH said adults had it.

Symptoms of schistosomiasis given by HH showed that they were clearly able to recognise the disease with blood in the urine (79.4%),weight loss (8.3%) and tiredness (5.7%) the only significant symptoms reported. There was a high correlation between the symptoms identified and claims that members of the family were infected (P=0.001) (Table 3.14). Knowledge of symptoms is probably derived more from experience than from teaching.

Schistosomiasis was conceived as a problem by 52.9% of HH, not a problem by 33.8% with 13.3% of HH not knowing. Perhaps not unexpectedly there was a high correlation between the belief that members of the family had schistosomiasis and the belief that it was a problem in the community (P=<0.001).

The transmission of schistosomiasis was less clearly understood with 31% of HH stating that they did not know how it was transmitted. 41.1% associated the disease with drinking dirty water and only 24.1% with contact with rivers and streams etc..

A proportion of the HH (28.7%) claimed to have been treated for schistosomiasis at one time or another with most of them (69%) being treated at a hospital, 25% at a clinic and 5% by a traditional healer. Having been treated for schistosomiasis had no influence on whether or not they believed the disease was a problem in the community (P=0.987).

Considering the sources of community water in terms of the risk of schistosomiasis transmission, boreholes, taps, protected and unprotected wells may be considered as safe while dams and rivers may be considered as unsafe. There was no correlation between the HH source of drinking water and infection in the family (P=0.967) (Table 3.15), however there was a very strong correlation between the HH washing site and the presence of schistosomiasis in the family (P=0.012) (Table 3.16).

There was no correlation (P=0.78) between the presence of a latrine in the household and the infection status, as judged by the respondent, of the family.

Table 3.15: The relationship between the source of drinking water for the household and whether the householder believes that members of the family are infected with schistosomiasis.

	INFECTION BELIEF		
	infected	uninfected	Total
safe water	133	135	268
unsafe water	17	17	34
Total	150	152	302

Table 3.16: The relationship between the household washing site and whether the household is believed to be infected with schistosomiasis.

	INFECTION BELIEF		
	infected	uninfected	Total
safe water	25	43	68
unsafe water	117	99	216
Total	142	142	284

3.5.2 Post-intervention survey.

The change in latrine type and prevalence from 1985 to 1988 is shown in Table 3.17.

There was no increase in the number of HH with functional latrines since 1985 in both Madziwa and Bushu. However, there was an increase in the number of latrines being constructed in Madziwa and in Bushu. The proportion of Blair latrines in Madziwa and in Bushu increased from 6.3% in 1985, to 90.4% and 81% respectively in 1988. Of the 74 Blair latrines in Madziwa (86.5%) were built between 1986 and 1988. During the same period, 12 (70%) of the Blair latrines were built in Bushu.

Most of the Blair latrines built in Madziwa and Bushu are of the double type and the number of pit latrines dropped from 83.3% in 1985 to 9.8% in Madziwa and 19% in Bushu by 1988.

The sanitation programme provided 5 bags of cement on request of the HH in Madziwa only. Most of the female heads of household questioned (76.1%) knew

Table 3.17: The number of latrines in Madziwa and Bushu in 1985 and in 1988.

	Madziwa & Bushu		Madziwa		Bushu	
	1985		1988		1988	
	No.	%	No.	%	No.	%
HH sampled	349	100	230	100	69	100
HH with latrines	114	32.7	82	35.7	21	30.4
Latrines under construction	22	6.3	35	15.2	7	10.1
Blair latrines	19	16.7	74	90.2	17	81.0
Pit latrines	95	83.3	8	9.8	4	19.0

Table 3.18: The perceived advantages of having latrines for those HH with latrines in Madziwa and Bushu in the 1985 and the 1988 surveys (percent).

	MADZIWA & BUSHU	MADZIWA	BUSHU
	1985	1988	1988
PERCEIVED ADVANTAGES	n=114	n=74	n=21
No smell	0.0	17.8	5.0
No flies	11.4	4.1	0.0
Privacy	21.9	43.8	30.0
Less disease	63.2	21.9	45.0
Close to HH	0.0	4.1	15.0
Others	3.5	8.2	5.0

Table 3.19: The perceived dislikes of latrines by HH with latrines in Madziwa and Bushu in 1985 and 1988 (percent).

	MADZIWA & BUSHU	MADZIWA	BUSHU
	1985	1988	1988
PERCEIVED DISLIKES	n=114	n=74	n=21
Smell	56.4	3.1	0.0
Flies	23.1	3.1	9.1
No privacy	0.0	1.6	0.0
Too much disease	0.0	4.8	0.0
None	18.0	83.6	85.9
Others	2.5	3.7	5.7

that the programme had supplied the cement for their latrine.

In 1985, 100% of the householders with latrines said that they used them. In the 1988 KAP, the latrines were utilised by 98.6% of householders in Madziwa, and by 100% in Bushu. Children below the age of 5 were still afraid of using latrines for fear of falling down the hole and the percentage changed from 9.6% in 1985 to 36% in 1988. The use of Blair latrines as wash rooms increased from 33.3% in 1985, to 64.9% of HH in Madziwa and to 71.4% of HH in Bushu. Using the Blair latrines as wash rooms is an encouraged practice.

There was a change from 1985 to 1988 in perception of the advantages in having a latrine with the emphasis moving away from the general health message of less disease towards probably more genuinely observed advantages of privacy, no smell and convenience (Table 3.18).

A very significant change ($p<0.001$) from 1985 to 1988 was seen in the likes and dislikes associated with latrines. In 1985 when 83.3% were traditional pit latrines the dislike of smell and flies was evident (Tables 3.18 & 3.19). By 1988 when the majority of latrines were ventilated there were hardly any complaints at all regarding latrines.

All 235 HH without a latrine or those who were in the process of building one in the 1985 survey passed urine and stool in the surrounding vegetation with the exception of one who used a communal facility. In the 1988 KAP survey 40%

Table 3.20: Sites from which drinking water is collected in Madziwa and Bushu (percent).

SOURCE	MADZIWA & BUSHU 1985 n=349	MADZIWA 1988 n=229	BUSHU 1988 n=69
House tap	3.2	0.0	0.0
Communal tap	8.3	10.0	0.0
Protected well	6.3	10.5	8.7
Borehole	19.8	38.0	72.5
Unprotected well	50.9	27.1	14.5
Natural water	11.5	14.4	4.3

of HH in Madziwa without latrines and 46% in Bushu used communal facilities. This was a significant increase from 1985 and probably reflects the use of a 'family' latrine by the extended family. In this respect the proportion of latrine users has changed from 33% in 1985 to 61.5% in 1988.

As found in 1985 almost all of those families without a latrine wanted one.

There was a higher proportion of HH fetching water for drinking from protected wells in the 1988 survey than in the 1985 survey (Table 3.20). However, there was no significant difference between the number of HH collecting water from protected wells in 1985 and in 1988.

The number of HH fetching water from boreholes was higher in the 1988 survey than in the 1985 survey and the difference was highly significant at $P< 0.001$. Also, the difference between Madziwa and Bushu was highly significant at $P< 0.001$. A lower proportion of HH collected water from unprotected wells in both Madziwa and Bushu in the 1988 survey than in the 1985 survey. The difference was highly significant at $P< 0.001$.

Unfortunately due to an oversight no follow up was made in the KAP study on the sites used for washing. Data on this can be seen from the section on water use.

The number of HH which boiled drinking water dropped from 9.8% in 1985 to 1.7% in Madziwa and 1.4% in Bushu in 1988 which is probably a reflection of sampling variation.

As in the pre intervention survey children were generally thought to be the ones mostly infected with schistosomiasis. The numbers thought to be infected were similar in both surveys.

Symptoms of schistosomiasis given by HH showed that they were clearly able to recognise the disease in terms of haematuria although the numbers of HH saying they did not know any symptoms increased from 6.6% in 1985 to 17% in 1988.

The perception of schistosomiasis as a problem in the area increased from 52.9% in 1985 to 86.9% in Madziwa and to 92.8% in Bushu by 1988. This trend probably resulted from the activities of the intervention programme itself which has raised the awareness of the community to schistosomiasis. This increased awareness is also matched by an increase in knowledge of some facts concerning

Table 3.21: Types of sites identified by householders as sources of schistosomiasis transmission.

	MADZIWA & BUSHU	MADZIWA	BUSHU
	1985	1988	1988
SITES	n=349	n=229	n=69
Dirty latrines	0.0	4.4	5.8
Dirty drinking water	41.1	20.1	13.0
Contact with dams/streams	24.1	37.6	42.0
Snails	0.0	0.4	0.0
Do not know	31.0	35.8	33.3
Others	3.8	1.7	5.9

the disease. Although about one third of HH did not know how schistosomiasis is transmitted there was still a significant increase in the proportion of HH which identified dams and streams as sources of schistosomiasis transmission from the 1985 to the 1988 surveys ($P<0.001$) (Table 3.21). However, there was no significant difference between Madziwa and Bushu in the 1988 survey.

The number of people treated for schistosomiasis increased from 28.7% in 1985 to 52.9% in Madziwa and to 63.8% in Bushu in 1988. The increase in the number of people treated since 1985, is attributed to the targeted chemotherapy component of the control programme.

3.5.3 Discussion.

Questionnaires, if not carefully constructed and administered, can result in the collection of biased data (Kloos et al, 1982) and it is virtually impossible to remove all bias due the natural desire on the part of the respondent to please or impress the enumerator. This must therefore be taken into account when interpreting knowledge attitudes and practices surveys. The advantage however is that such surveys provide a useful tool to obtain important relevant data on the community which is difficult to obtain by other methods.

The lack of adequate sanitation facilities is a problem common to virtually all developing countries. Of the one third of HH in the present study area with latrines the vast majority of these were the ordinary pit latrine which are known by all familiar with them to be unpleasant to use due to the smell and flies. These were also the most common dislikes of the latrines raised by the HH in this study. The result is that people in less crowded environments prefer to use the bush for excreta disposal.

Farooq et al (1966b) found that schistosomiasis was lower in households with latrines than in those without although they did not consider this to be a causal relationship. No such correlation was found in the present study although the methods used were much less sensitive. People may have been reluctant to criticise latrines to 'officials' which may explain the low proportion of HH (34%) who gave any dislikes of their latrine. The advantages of the Blair VIP latrine are however clear in the 1988 survey where the control of flies and odours is evident.

Since Bushu was a control area, provision for sanitation was not part of the project although there were some resources made available to Bushu as part of normal activities of the Provincial Health Team. As a result there has been some construction of Blair latrines in the area. There has been a marked decline in the number of pit latrines in Madziwa and Bushu and the most likely explanation seems to be that those people who had had pit latrines were the ones most motivated to upgrade them to the Blair ventilated latrines. Overall the number of households with latrines has also increased.

There has been a considerable amount of health education regarding sanitation and hygiene in the rural areas of Zimbabwe since the introduction of the Village Health Worker programme in 1981 and this is shown by the almost unanimous wish to have a latrine with the main reason being given as less disease. Sanitation programmes are being promoted in Zimbabwe without specific reference to schistosomiasis control but as part of a programme to improve health generally and help reduce diarrhoeal disease, the most common cause of death in infants. It was observed that after experiencing the VIP latrines the population felt that a clear benefit of having a latrine was privacy unlike in 1985 where the 'official' view of less disease was given.

Of concern is the large number of infants who do not use the latrines and more specific education messages are needed to address this issue. Since most families use the latrines as washrooms, the life span of the latrines are going to be as long as 15-20 years (Morgan, pers comm.). When used as a washroom, the latrine floor is washed down thoroughly and this cuts down on potential odours caused by urine being absorbed into the cement floor. The added water increases the rate of decomposition of the contents of the pit.

An interesting result of the study was the very clear separation of water sources for different activities. Workers in Zimbabwe (Chandiwana, 1987b; Husting, 1970) and in St Lucia (Dalton, 1976) have shown that different contact points on streams are used for different activities by different social groups within the community. In the present situation HH collected drinking water from sites different from those where washing was performed. This was presumably due to the differing quality of the water at the sites and the different requirements in terms of water quantity, quality and surrounding amenities such as rocks and bushes on which to hang clothes. This was also evident from the water use study which showed the preference for washing clothes at sites with abundant water as well as appropriate facilities.

Macdonald (1965) has shown that sanitation alone may not play a very significant role in the control of schistosomiasis. However as an adjunct to a control programme based on other measures, it increases the probability of success of other measures and is equally effective in reducing the risk of reintroduction following successful control. Thus to obviate the prolonged use of drugs it is important that schistosomiasis control programmes are aimed at long term control through improved sanitation, water supplies and education which serve to reduce the risk of reinfection .

Macdonald (1965) in theory and Jordan et al, (1978) in practice showed that a reduction in contact with potentially contaminated water made a significant contribution to control of schistosomiasis. The present study shows very clearly that merely to provide water points without any consideration as to the other amenities may result in those water points having limited use for the community and thus have little effect on the transmission of schistosomiasis. Historically, many of the protected water points in Zimbabwe, such as boreholes, have had no consideration given to the users and the surrounds are often muddy and exposed to cattle with poor drainage and no washing facilities. Despite these unhygienic conditions these water points are often over utilised due to the limited number of facilities with clean water. Such facilities are clearly unsuitable for a major household activity, washing clothes, and consequently most householders continue to use their traditional source, the river, for this activity.

Washing also requires a considerable volume of water and a water point serving over 30-40 families is likely to be too congested to allow washing to take place at the facility. The HH recognise where they get the best drinking water as shown by the fact that only a small proportion take their drinking water from a river or dam. Boiling of water is not a common practice but is often recommended by health personnel and this could influence the answer given by respondents to this question.

Basic facts about the life cycle of schistosomiasis were poorly understood by the householders with initially only about one quarter associating the disease with contact with dams, rivers, streams etc. However the majority still associated the disease with some form of water-related behaviour and thus this was considered a good indicator for successful community support for action connected with water supplies. By the end of the study the association of schistosomiasis with natural water bodies significantly increased reflecting a better understanding by the community. The 'don't knows' were not reached by the programme and remained at about 33% of HH.

S. haematobium is the most common species of schistosome in Zimbabwe (Taylor & Makura, 1985). Parasitological results from the present study show that *S. haematobium* is the most common species with *S. mansoni* having a low frequency and intensity of infection (Taylor, 1986). The average prevalence of *S. haematobium* in children was about 50% and it is interesting that this closely approximates the proportion of HH who felt that schistosomiasis was a problem (52.9%). It is relevant therefore that the community knowledge of symptoms is related to those associated with *S. haematobium* with haematuria the most frequent symptom mentioned.

Farooq et al, (1966b) not only found that occupation influenced prevalence with the highest prevalences amongst fishermen and boatmen but also found that females washing clothes and utensils in canals have significantly higher infection rates than those who used piped water. Although no studies were carried amongst the HH to determine the different amounts of contact associated with different household and occupational activities there was a clear relationship between the HH reporting schistosomiasis as a problem and those HH doing there washing of clothes in rivers and dams. The water use study reported earlier agrees with Husting (1970) and Chandiwana (1987b) also working in Zimbabwe, that washing of clothes is the most common activity which accounts for the most time spent at water contact points and therefore this activity is likely to be a major factor in schistosomiasis transmission. Washing activities have been found to be the predominant activity in the dry season being overtaken by swimming in the wet season (Tayo et al, 1980).

Tayo et al, (1980) observed very few women having water contact due possibly to their selection of sites or to social/religious attitudes which may have resulted in an underestimate of washing activities (Farooq et al, 1966a). Even though washing is considered to be an exposure activity rather than contamination it is common practice in Zimbabwe for women to take their younger children to the river when washing rather than leave them at home. These children then engage in other recreational water contact activities which would otherwise not take place, allowing for both exposure and contamination. This behaviour pattern is supported by the high infection rates observed for the children under 7 years in the present study (Age Prevalence 3.8).

Knowledge attitudes and practices surveys, as with behavioural studies of water contact, may be difficult to compare between different communities due to social and cultural differences as well as varying methodologies of implementing the studies. They are most useful in longitudinal programmes where these variables are minimised by a standardised methodology used in the same community.

3.6 CHEMOTHERAPY

3.6.1 School surveys.

School surveys for schistosomiasis and treatment with praziquantel were carried out on three occasions, Jan/Feb 1986, Sept/Oct 1986 and Sept/Oct 1987. The numbers of children examined and treated is shown in Table 3.22.

Table 3.22: Data on the number of children examined for haematuria, number treated with praziquantel, number of tablets and the mean dose for treatment periods Jan/Feb, Sept/Oct 1986 and Sept/Oct 1987.

	EXAMINATION & TREATMENT PERIOD		
	Jan/Feb 1986	Sept/Oct 1986	Sept/Oct 1987
No. children	15,161	13,692	13,254
No. treated	9,997	5,132	5,895
No. tablets (600mg)	21,010	11,427	12,205
Mean dose (mg/kg)	37.2	37.5	38.9

Six members of staff conducted the screening and treatment exercises in the schools. The operation was carried out following the flow chart in Figure 3.7 with

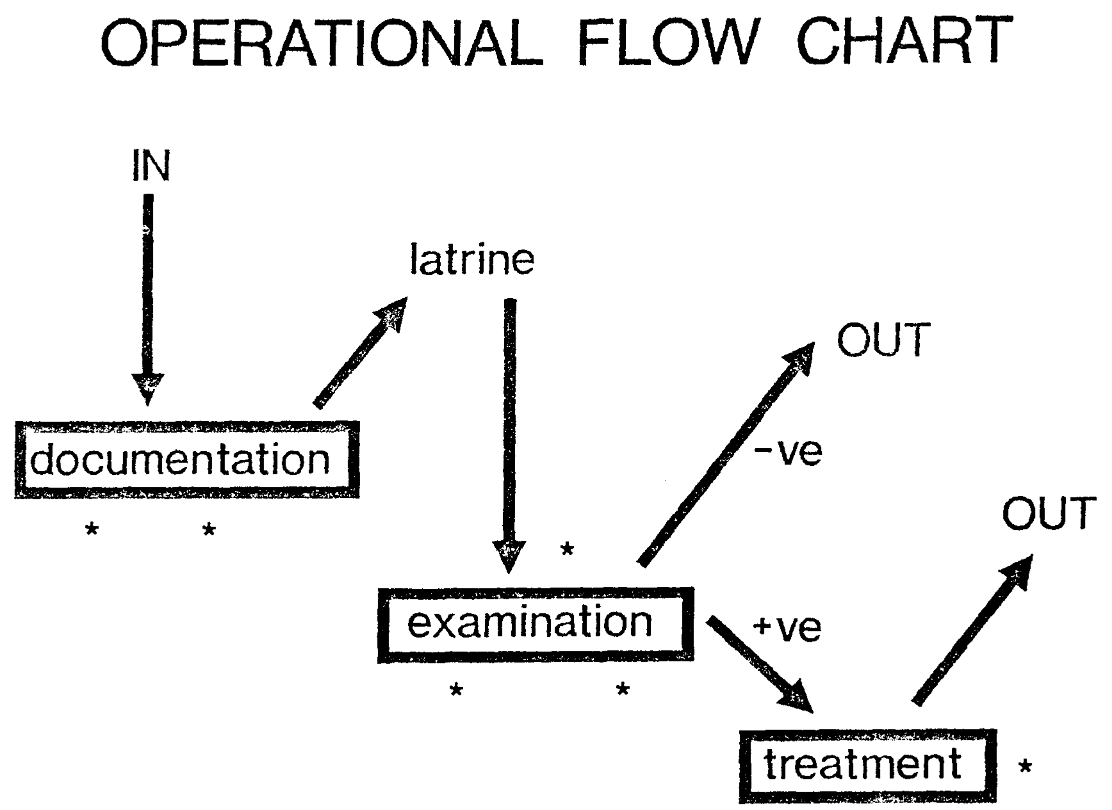


Figure 3.7: Flow diagram for the examination and treatment of school children for schistosomiasis.

some assistance from the teachers to control the children. The registration forms were completed by each teacher using the class register before the class was called for investigation. Each class was then called in turn and with assistance from the teacher the children lined up at station 1 (Figure 3.7). Two staff members at this station checked the child against the registration form, marked the pupils hand using a felt marker with the same number as on the registration form and distributed a similarly numbered bottle to the child. The purpose of the exercise was explained to the pupils and they were requested to produce a specimen of urine into the bottle. Every fifth child (numbers ending in a zero or a five) was given a second bottle with a paper towel and wooden spatula and requested to place a small quantity of stool in the bottle as both the urine and stool samples of these children were to be examined for schistosome eggs. When the children were sent off to the latrines the record forms were handed to the recorder at station 2 (Figure 3.7).

On return from the latrine the children lined up at station 2 (Figure 3.7), the examination table manned by two people, where the number on the bottle was checked against the number on the child's hand and the urines were checked for haematuria. The recorder controlled the pupils arriving at the examination table, recorded the results and directed the pupils after the examination results were known. All reagent strip negatives were sent back to class while positives were referred to station 3 (Figure 3.7), the treatment table, for administration of praziquantel. Record forms were then handed to the treatment table (Figure 3.7).

At the examination table the specimens for parasitology were separated for return to the laboratory for later parasitological examination.

One person, usually with some assistance from the teacher, weighed the children at the treatment table, administered praziquantel ensuring the tablets were actually swallowed and then sent the children back to class.

Prevalence of *S. haematobium* was initially very high as shown both from the reagent strip results and from the parasitology but was reduced substantially by the first treatment as shown by the much lower prevalence on examination 6 months later in Sept/Oct 1986 (Table 3.23). Similarly *S. mansoni* prevalence declined from an average of 17.5% to 2.9% after the first treatment (Table 3.24). The twelve month period before the third treatment resulted in a considerable amount of reinfection although the method of examination produced differing results (Tables 3.23 & 3.24).

From the reagent strip results only 14 schools from the 26 experienced an increased prevalence from the second to the third treatment whilst by parasitology 22 schools experienced an increase in prevalence. As is shown in the section on evaluation of the reagent strip there was a real and significant increase in infection over this period. The reagent strip results for the Sep/Oct 1986 examination followed within 6 months of treatment and this is believed to have resulted in an overestimate of the infection status. This is discussed in full below.

3.6.2 Distribution of schistosomiasis.

The effect of treatment on the distribution of schistosomiasis in Madziwa and Bushu is shown in Figures 3.8 & 3.9. *S. mansoni* was reduced in both areas to low levels and in terms of the prevalence categories did not show much reinfection. At the second examination 75% of 53 villages in Madziwa and 93.8% of Bushu villages, had 0% +ve for *S. mansoni*. By the third examination 58.5% of Madziwa villages and 68.8% of Bushu villages were negative indicating reinfection with *S. mansoni*.

S. haematobium did show considerable reinfection 12 months after the second treatment (Figures 3.8 & 3.9). A marked reduction in prevalence was noticeable from the first to the second examination but this was reversed quite rapidly in many villages by the third examination. Some villages in Madziwa did not respond very well even to the first treatment and the greatest reinfection took place in those villages which had previously had a high prevalence and were usually in close proximity to permanent water (Figures 2.1, 2.2, 3.8 & 3.9).

Discussion.

The time between the first treatment and the second was 6 months and between the second and the third treatment, 12 months. This is very important in relation to reinfection as one intention of the study was to determine the optimum interval between treatment and retreatment. This interval has a marked effect on the overall cost of schistosomiasis control programmes and therefore their sustainability

Table 3.23: Results of school treatment programmes carried out in Jan/Feb 1986, Sept/Oct 1986 and Sept/Oct 1987 showing percentage of children positive for haematuria by reagent strip or positive for *S. haematobium* eggs.

SCHOOL	REAGENT STRIP % +ve			PARASITOLOGY % +ve		
	Jan/Feb 1986	Sep/Oct 1986	Sep/Oct 1987	Jan/Feb 1986	Sep/Oct 1986	Sep/Oct 1987
Mfurudzi	50.3	55.8	39.4	62.1	27.3	35.8
Chidembo 1	63.9	55.2	54.4	72.2	39.6	39.5
Chidembo 2	65.7	33.6	41.1	68.7	16.0	23.5
Mutumba 2	49.3	34.0	31.1	36.4	16.0	11.9
Mutumba 1	59.0	39.1	50.3	54.5	25.8	31.7
Nyarakunda 1	48.0	26.3	44.7	53.0	18.1	25.2
Nyarakunda 2	35.6	31.9	22.7	52.2	19.0	15.3
Bradley	44.2	33.8	26.7	51.6	0	6.3
Rusunungoko	69.1	39.6	50.8	73.5	21.3	45.3
Nyamaropa	72.8	38.3	58.2	69.6	18.9	35.8
Mushowani	64.6	31.7	41.1	62.3	13.0	22.4
Madziwa 1	84.9	31.1	33.8	47.1	12.8	31.4
Madziwa 2	46.3	33.8	26.1	48.4	8.2	16.9
Kaziro	72.3	27.2	39.7	70.6	20.8	21.7
Chiimbira	80.1	44.6	62.4	56.0	28.2	59.7
Chihuri 1	80.7	31.1	58.5	72.3	19.0	52.7
Chihuri 2	67.4	36.5	34.1	45.5	14.3	4.9
Mupfure 1	75.6	42.3	42.6	68.5	31.3	38.7
Nyamaruro	67.3	25.4	50.7	71.6	22.2	43.8
Mupfure 2	87.3	57.7	64.2	77.3	17.4	65.3
Jiti 2	61.9	40.7	39.9	60.0	11.4	29.6
Gono	77.5	49.4	37.4	69.7	14.1	38.0
Jiti 1	83.7	32.6	54.1	83.3	17.6	54.1
Bushu 2	63.1	37.9	23.5	66.7	5.8	16.4
Bushu 1	53.4	51.3	29.3	53.0	6.7	12.5
Chishapa	61.7	38.6	31.9	59.2	26.3	21.3
AVERAGE	65.9	37.5	44.6	62.3	19.4	34.2

Table 3.24: Results of school treatment programmes carried out in Jan/Feb 1986, Sept/Oct 1986 and Sept/Oct 1987 showing percentage of children positive for *S. mansoni* eggs.

SCHOOL	% +ve *S. mansoni*		
	Jan/Feb 1986	Sept/Oct 1986	Sept/Oct 1987
Mfurudzi	16.2	5.8	6.6
Chidembo 1	18.3	7.6	10.7
Chidembo 2	14.3	4.8	25.0
Mutumba 2	22.1	1.3	3.0
Mutumba 1	17.4	2.3	2.2
Nyarakunda 1	7.1	2.8	3.5
Nyarakunda 2	14.9	1.6	9.9
Bradley	17.6	0	11.4
Rusunungukо	31.8	9.1	16.7
Nyamaropa	15.0	1.3	4.7
Mushowani	12.8	0	7.0
Madziwa 1	14.2	3.0	5.4
Madziwa 2	15.8	2.7	12.2
Kaziro	26.7	4.5	10.7
Chiimbira	13.2	5.4	7.7
Chihuri 1	22.3	1.0	14.3
Chihuri 2	13.4	0	17.6
Mupfure 1	22.0	7.5	21.4
Nyamaruro	13.6	5.6	13.7
Mupfure 2	47.6	4.5	12.5
Jiti 2	24.2	0	8.1
Gono	14.7	0.8	1.0
Jiti 1	21.4	0	8.3
Bushu 2	38.1	2.0	3.4
Bushu 1	14.0	0	0
Chishapa	2.4	0	7.5
AVERAGE	17.5	2.9	8.2

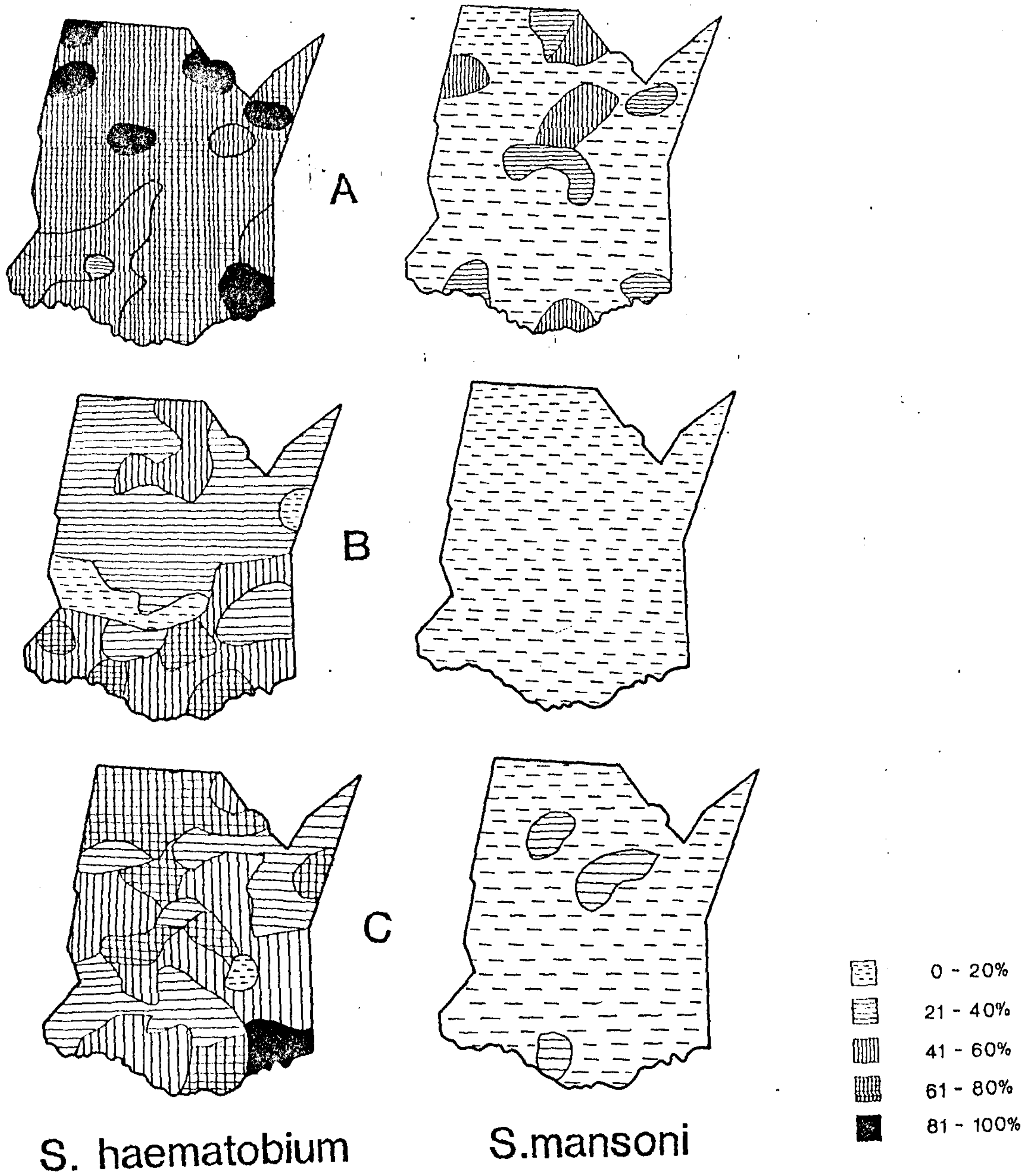


Figure 3.8: Change in prevalence of *S. haematobium* and *S. mansoni* in Madziwa over the three examination and treatment periods. A. Jan/Feb 1986. B. Sept/Oct 1986. C. Sept/Oct 1987.

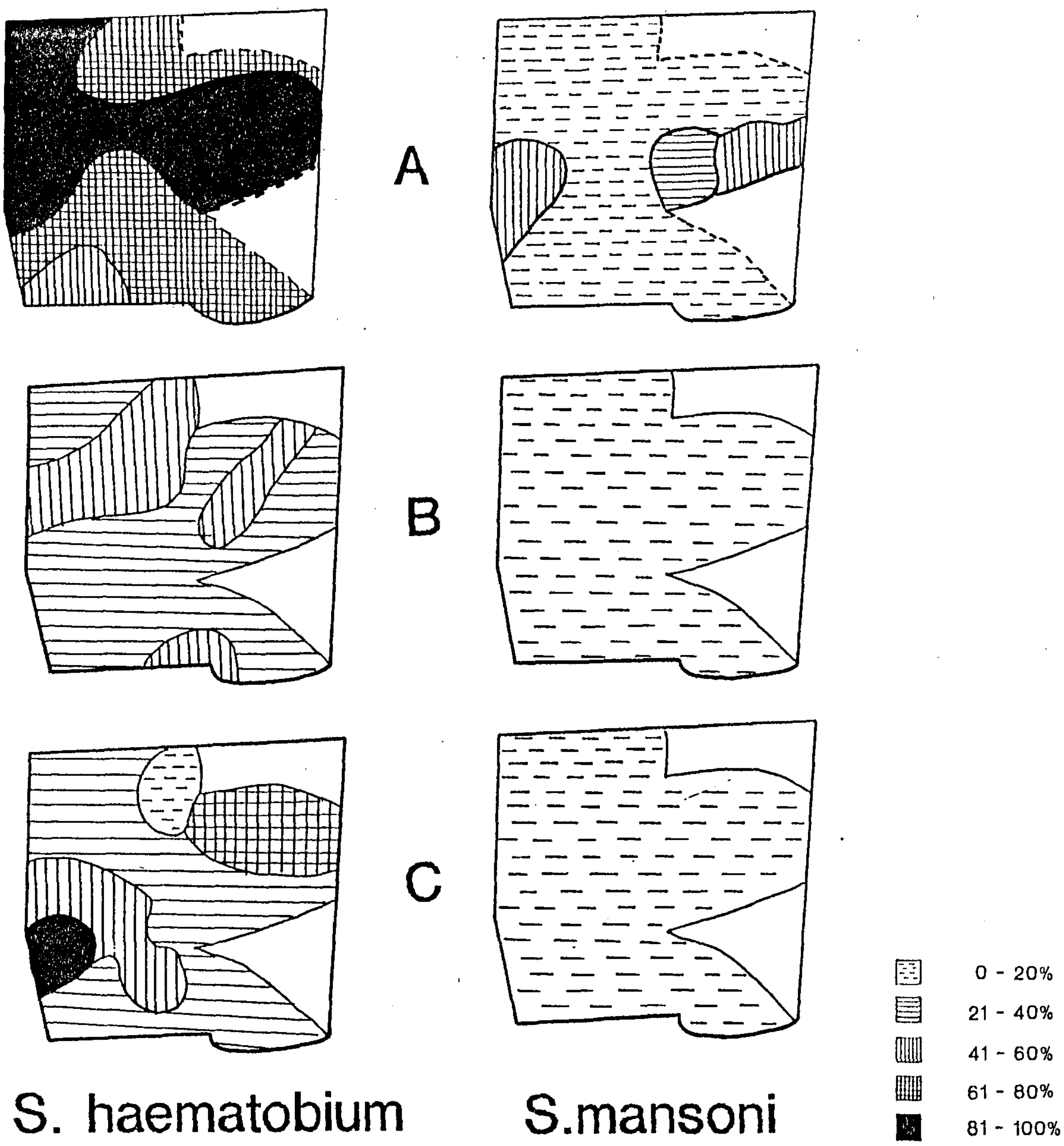


Figure 3.9: Change in prevalence of *S. haematobium* and *S. mansoni* in Bushu over the three examination and treatment periods. A. Jan/Feb 1986. B. Sept/Oct 1986. C. Sept/Oct 1987.

(Taylor et al, 1988). The present study has shown that in areas of high prevalence and transmission, reinfection can be very rapid necessitating an annual treatment.

Whilst there have been varied reports in the literature on reinfection interval (Davis et al, 1981; Mott et al, 1985c; Sukwa et al, 1987; Wilkins et al, 1987) this is clearly dependent upon the transmission dynamics of the particular area. However different age groups may exhibit differing reinfection patterns within the same community (Wilkins et al, 1987; see also reagent strip results below) due to differences in immunity and exposure behaviour.

Treatment interval will need to be determined for each control programme and revised regularly according to whether transmission is being reduced or not. The heterogeneity of transmission of schistosomiasis is shown particularly in the maps of reinfection (Figures 3.8 & 3.9). Prior to treatment prevalence would appear to have stabilised at a uniformly high level but the rate of return to that level after treatment varies greatly from area to area. A simple technique is needed to be able to identify these areas in order to make schistosomiasis control as efficient as possible and further investigation is needed into the use of reagent strips by school teachers to assess the schistosomiasis problem at regular intervals after treatment.

3.7 EVALUATION OF THE REAGENT STRIP TECHNIQUE.

The coverage, number of children treated and number of praziquantel tablets used in the three programmes are shown in Table 3.22. Of the children examined for haematuria on each occasion 65.9%, 37.5% and 44.5% were treated with praziquantel on the basis of a positive test for Jan/Feb 1986, Sept/Oct 1986 and Sept/Oct 1987 respectively.

At the first examination 6.6% of children had visible blood in the urine. This declined after the first treatment to 0.9% then 12 months later was 1.3%.

3.7.1 Reagent strip sensitivity and specificity.

The sensitivity (proportion of parasitologically positive urines with a positive haematuria test) changed from 80.6% at the first examination in Jan/Feb 1986 to 67.2% in Sept/Oct 1986 and 78.1% in Sep/Oct 1987.

The specificity (proportion of parasitologically negative urines with a negative haematuria test) was 63.2%, 71.1% and 72.5% for each subsequent examination indicating that the number of false positives decreased progressively after the first treatment.

Table 3.25 shows the sensitivity of the reagent strip test for *S. haematobium* infections of different intensities. It can be seen that the sensitivity increases with the intensity of infection and this pattern is similar for all examination periods (Table 3.25).

Table 3.25 also indicates that there was a decline in sensitivity of the haematuria test for all intensity groups following the first treatment although there

Table 3.25: The reagent strip sensitivity and specificity in relation to the intensity of *S. haematobium* infection on each sampling occasion.

INTENSITY CLASS		JAN/FEB 1986	SEP/OCT 1986	SEP/OCT 1987
0	Specificity	63.2	71.1	72.5
1-16eggs	Sensitivity	72.7	61.0	69.9
17-49eggs	Sensitivity	88.5	81.7	87.6
50+eggs	Sensitivity	97.6	93.5	96.7

were no significant differences in the mean egg count in the intensity groups 1–16 eggs/10ml and 17–49eggs/10ml between the first examination to the second. With the longer interval between the second and third treatment the sensitivity almost returned to the levels observed at the first examination (Table 3.25).

3.7.2 Impact of treatment on prevalence and intensity of *S. haematobium* and haematuria.

The changes in the overall prevalence and intensity of *S. haematobium* following treatment are shown in Figure 3.10 as measured by the presence of *S. haematobium* eggs in the 20% subsample examined by parasitology and in Figure 3.11 as measured by haematuria in the whole sample. The treatment programme resulted in a marked decrease in the number of infected children and the intensity of infection (Figure 3.10). The fall in the frequency of the high intensity classes is more evident for the parasitology results than the haematuria but in both cases the lightest intensity category represents a greater proportion of the infections remaining after treatment (Figures 3.10 & 3.11).

Haematuria measured on all children gives an index of the efficacy of the treatment programme at the different treatment intervals (Figure 3.11).

3.7.3 Impact of treatment on prevalence and intensity of *S. mansoni*.

Treatment was based on the diagnosis of *S. haematobium* using haematuria as a diagnostic indicator but the drug used, praziquantel, is active against both *S. haematobium* and *S. mansoni*. The changes in the prevalence of *S. mansoni* observed following the treatment programme are shown in Table 3.26. There was a general decline in infection with *S. mansoni* although at the last examination the number in the heavy infection group was higher than had been found previously and there were indications of significant reinfection.

3.7.4 Influence of age.

The effects of the treatment programme on the age related prevalence of visible blood and reagent strip blood are shown in Figures 3.12 & 3.13. Treatment reduced

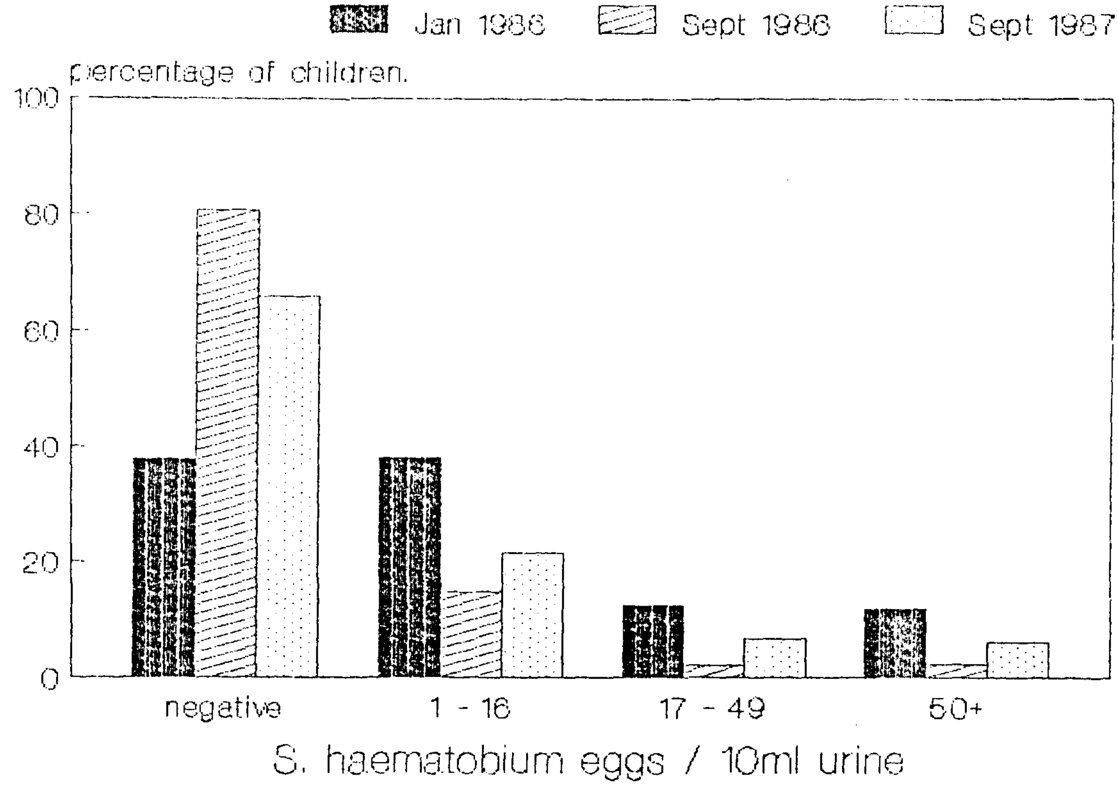


Figure 3.10: The results of examination of a 20% sample of urines taken pretreatment (Jan/Feb 1986) 6 months post treatment (Sept/Oct 1986) and 12 months after the second treatment (Sept/Oct 1987) showing the percentage of children in categories of increasing *S. haematobium* egg output.

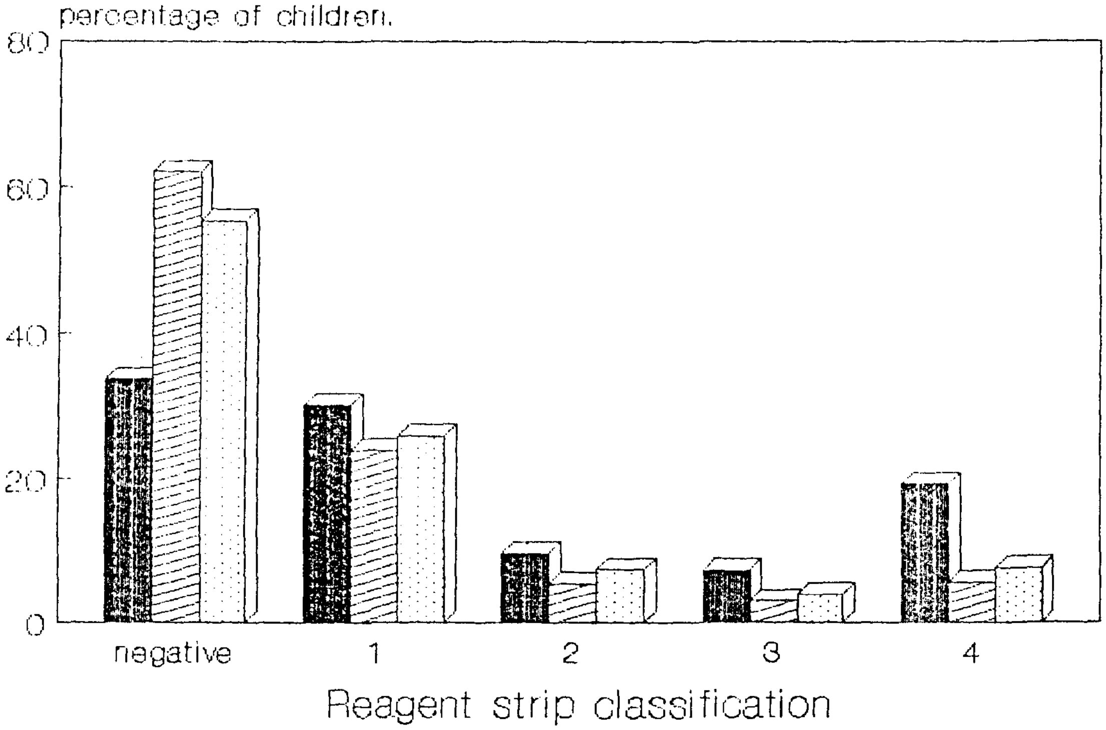


Figure 3.11: The results of the reagent strip test carried out on all children pretreatment (Jan/Feb 1986) 6 months post treatment (Sept/Oct 1986) and 12 months after the second treatment (Sept/Oct 1987) showing the percentage of children in categories of increasing haematuria intensity.

Table 3.26: Comparison of pre- and post- treatment intensity of *S. mansoni* infection (eggs/Kato slide) showing the percentage of individuals in each category.

EXAMINATION PERIOD		STOOL (Eggs/Kato slide) NEGATIVE	1-4	5-16	17-33	33+	TOTAL
Jan/Feb 1986	No.	1877	314	67	15	2	2275
	%	82.5	13.8	2.9	0.7	0.1	
Aug/Oct 1986	No.	2349	62	5	2	0	2418
	%	97.1	2.6	0.2	0.1	0	
Sep/Oct 1987	No.	1974	96	35	3	43	2151
	%	91.8	4.5	1.6	0.1	2.0	

visible blood to low levels in all age groups and reoccurrence was most evident in the age groups below 13 years (Figure 3.12). Reagent strip positivity was also reduced following the treatment and as with visible blood the longer interval of 12 months between the second examination and treatment and the third examination resulted in a significant amount of reinfection which decreased with age (Figure 3.13). The effect of the treatment programme on *S. haematobium* prevalence and prevalence of heavy infections is shown in Figures 3.14 & 3.15. The same pattern is evident as for haematuria (Figures 3.12 & 3.13) with reinfection and especially heavy infections (Figure 3.15), being greatest in the age group 7–9 years and decreasing with age. The prevalence of *S. mansoni* infection and heavy infection by age group following each treatment is shown in Figures 3.16 & 3.17. This pattern differs from that associated with *S. haematobium* (Figures 3.11–3.14) in that reinfection does not decrease with age and appears to be high in all age groups studied (Figures 3.16 & 3.17).

3.7.5 Discussion.

The present study showed that a team of six people could examine and treat 500 pupils in about 3–4 hours. In the implementation of a control programme with treatment based on a diagnosis of haematuria it would be feasible to screen and treat 800–1000 children in one day using a team of six.

Targeting treatment to children at school is the most feasible way to implement chemotherapy in Zimbabwe as it has proven difficult and time consuming to gather village communities together for the purpose of collecting stool and urine specimens and attendance decreases with repeated visits. In contrast school children are an easily accessible and controlled group who also have the highest infection rates in the community (Pugh, 1979; Taylor & Makura, 1985).

The first examination with reagent strips in Jan/Feb 1986 gave results in good agreement with the parasitology examinations and the success of the treatment programme was seen by the reduction of 68.9% in the prevalence of parasitologically proven *S. haematobium* infection at the second examination (Figure 3.8). The method proved to be very successful in removing heavy infections (>50eggs/10ml) which declined to about 2% of the population after the first treatment but rose to

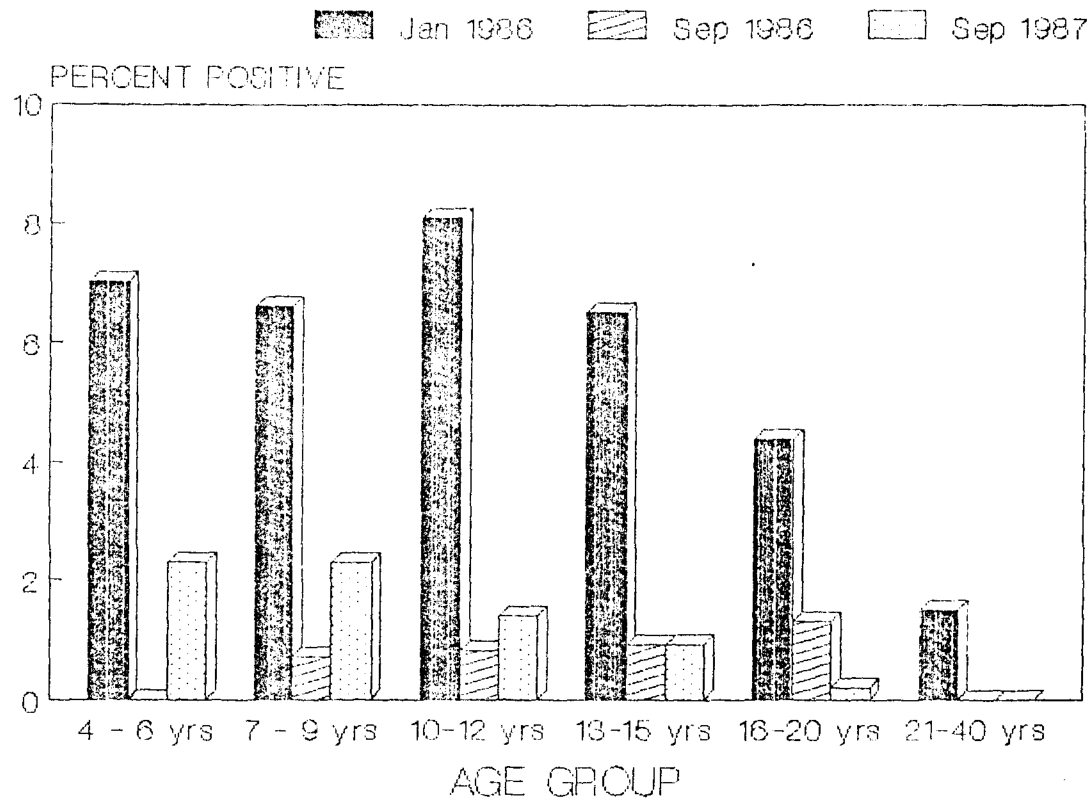


Figure 3.12: The age prevalence of visible blood in the urines of all children examined pretreatment (Jan/Feb 1986) 6 months post treatment (Sept/Oct 1986) and 12 months after the second treatment (Sept/Oct 1987).

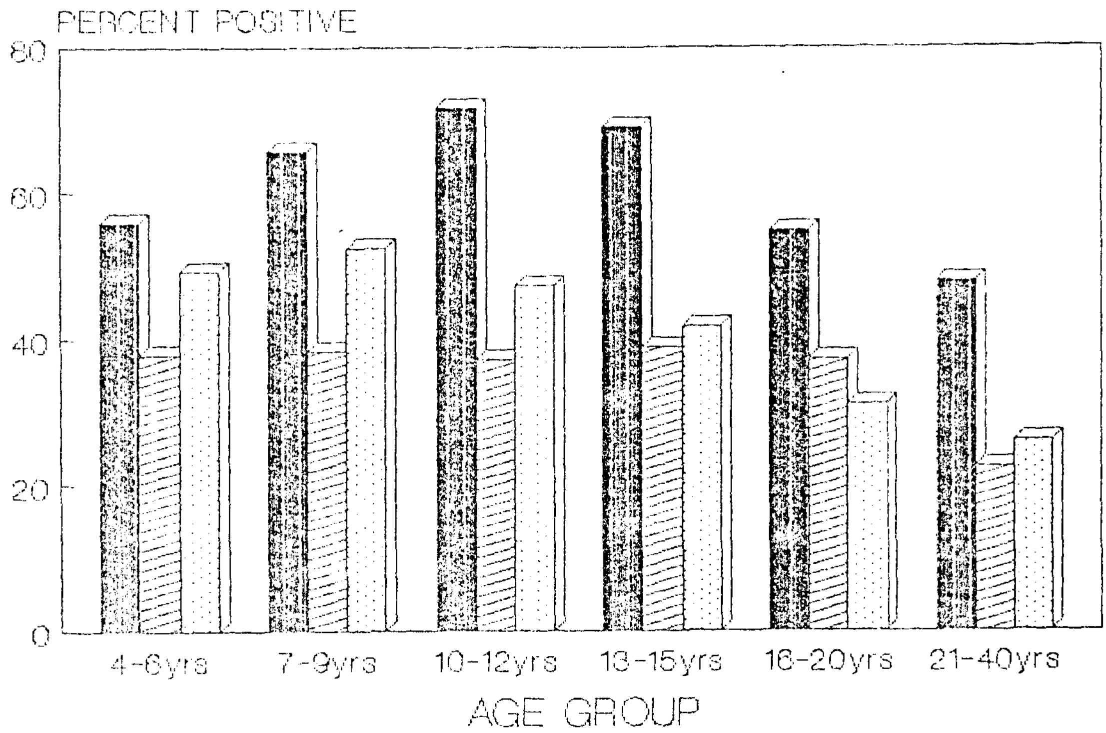


Figure 3.13: The age prevalence of positive reagent strip haematuria in the urines of all children examined pretreatment (Jan/Feb 1986) 6 months post treatment (Sept/Oct 1986) and 12 months after the second treatment (Sept/Oct 1987).

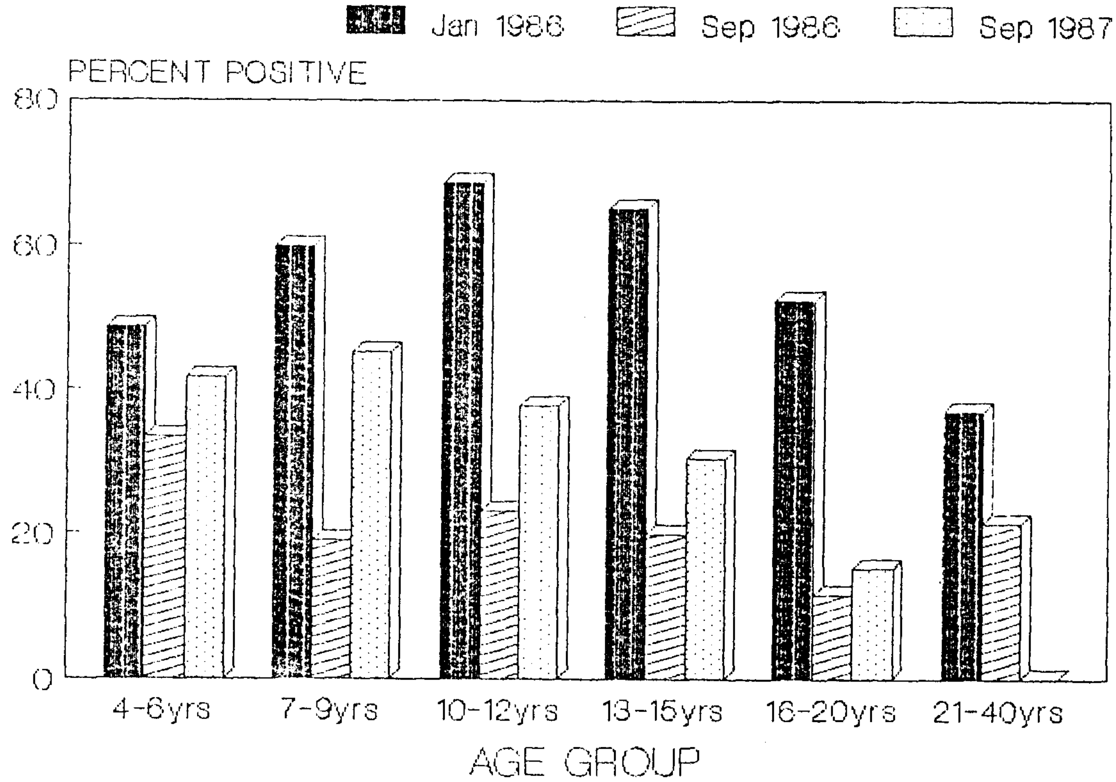


Figure 3.14: The age prevalence of *S. haematobium* infection detected by parasitology of a 20% sample of urines examined pretreatment (Jan/Feb 1986) 6 months post treatment (Sept/Oct 1986) and 12 months after the second treatment (Sept/Oct 1987).

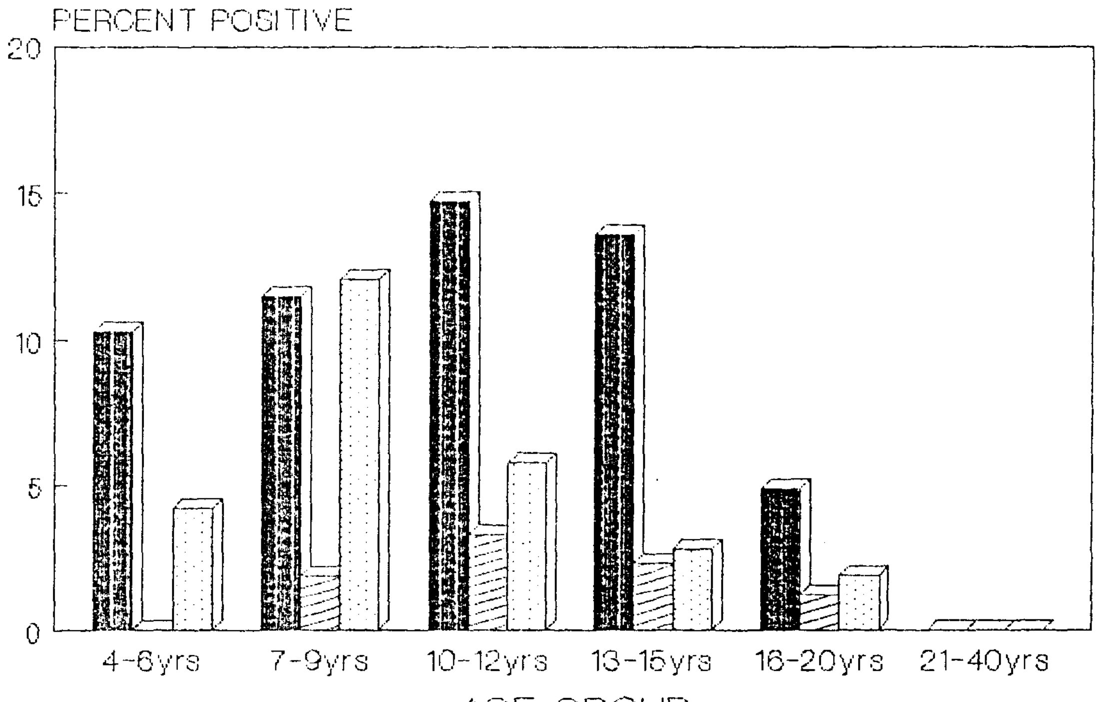


Figure 3.15: The age prevalence of heavy (>50 eggs/ 10ml urine) *S. haematobium* infections detected by parasitology of a 20% sample of urines examined pretreatment (Jan/Feb 1986) 6 months post treatment (Sept/Oct 1986) and 12 months after the second treatment (Sept/Oct 1987).

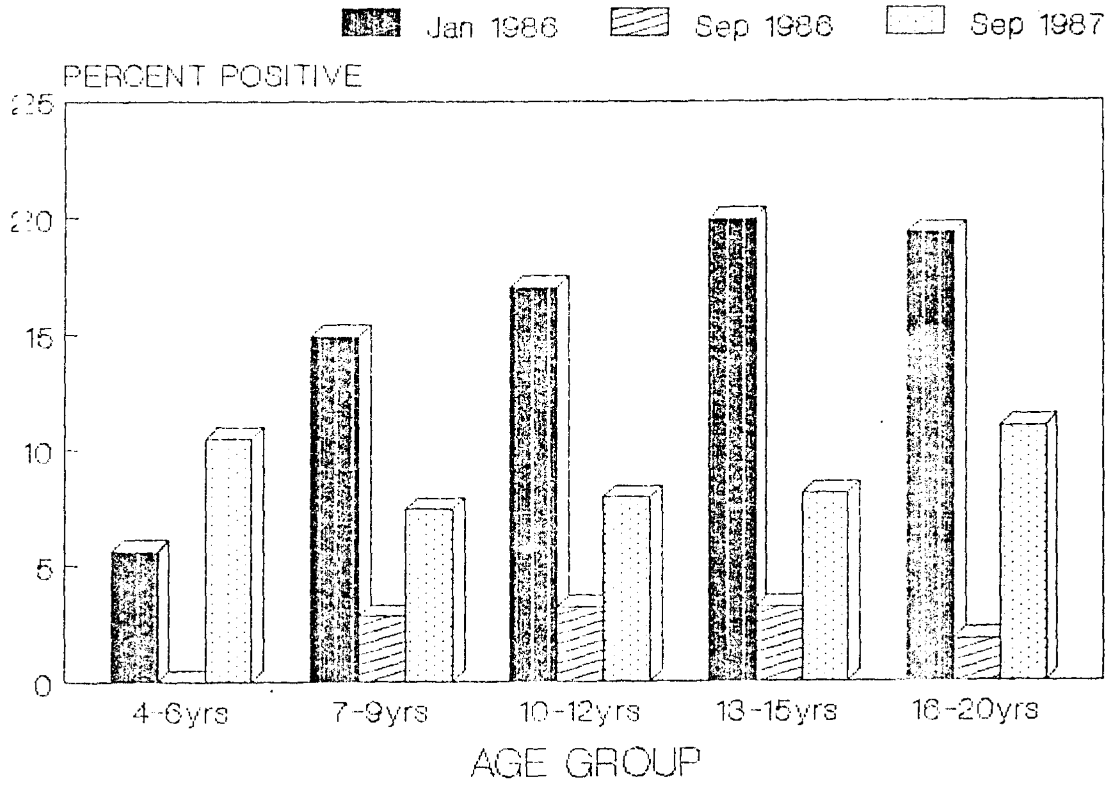


Figure 3.16: The age prevalence of *S. mansoni* infection detected by parasitology of a 20% sample of stools examined pretreatment (Jan/Feb 1986) 6 months post treatment (Sept/Oct 1986) and 12 months after the second treatment (Sept/Oct 1987).

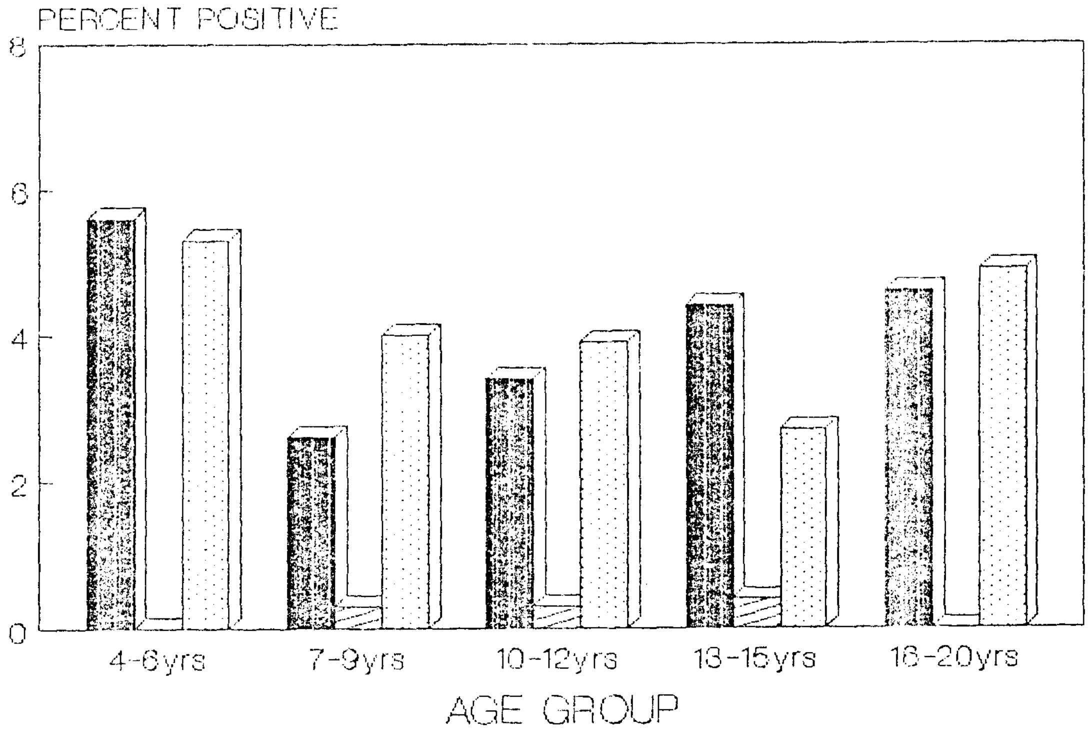


Figure 3.17: The age prevalence of heavy (>100 eggs/ g stool) *S. mansoni* infections detected by parasitology of a 20% sample of stools examined pretreatment (Jan/Feb 1986) 6 months post treatment (Sept/Oct 1986) and 12 months after the second treatment (Sept/Oct 1987).

6% with a longer treatment interval (Figure 3.8) indicating significant reinfection.

As a diagnostic tool for the treatment of *S. haematobium* infections in school children, haematuria has proven to be a very effective technique which saves a considerable amount of time over conventional parasitological methods (Pugh et al, 1980; Murare & Taylor, 1987). The good agreement found between the reagent strip results (66.2% +ve) and the parasitology (62.3% +ve) in Jan/Feb 1986 did not persist after the first treatment. At the second examination haematuria displayed a prevalence (36.3%) considerably higher than indicated for the parasitology (19.4%) and similarly for the Sept/Oct 1987 examination (44.6% +ve and 34.2% +ve). Schistosomiasis is the predominant cause of haematuria in this age group (Mott et al, 1983; Mott et al, 1985a) suggesting that observed false positive haematuria is actually caused by light schistosomiasis infections not diagnosed by parasitology. This is supported to some extent in that non specific haematuria decreased from 36.8% to 28.9%, then 27.5% following praziquantel treatment indicating that the praziquantel is treating infections not detected by parasitology.

Murare & Taylor (1987) emphasise the community specific nature of morbidity associated with *S. haematobium* infection as indicated by the range in geometric mean egg counts associated with each category of haematuria. Mott et al, (1983) showed clearly that increasing haematuria categories were associated with increasing mean egg counts. However the reverse is more logically correct and is seen as an increasing sensitivity of the haematuria test with increasing intensity of *S. haematobium* infection (Table 3.25; Tanner et al, 1983).

It is therefore clear that proper evaluation of the changing infection status of the population and the sensitivity and specificity of the reagent strip test should be carried out whenever this technique is being used in schistosomiasis control programmes. This would allow informed decisions on the most cost effective diagnostic and treatment measures to be undertaken to suit the prevailing circumstances.

Control strategies involving chemotherapy inevitably must envisage periodic retreatment. The interval between successive treatments greatly influences the cost and therefore the feasibility of such control programmes. The present study showed reinfection taking place after 12 months but as reinfection rates differ from locality to locality due to the heterogeneity in transmission of schistosomiasis (Woolhouse & Chandiwana, 1989) a more detailed analysis of the present data could therefore have shown areas of very high reinfection requiring retreatment. It is not yet clear how morbidity changes in relation to treatment and reinfection as most studies so far reported deal with the chronic relationship developed from long term exposure to schistosomiasis. Any control effort using chemotherapy must therefore maintain a continuous evaluation of the treatment frequency in relation to reinfection rates and measurements of morbidity.

Whilst visible blood may be used as an indicator of the *S. haematobium* infection status in a community our experience has been that it only occurs at a relatively low frequency and is highly susceptible to treatment (Figure 3.10) suggesting that it may not be a sensitive enough measure for planning control.

Age is well documented as a major factor affecting schistosomiasis prevalence and intensity (e.g. Pugh, 1979; Taylor & Makura, 1985) and it is further evidence of the usefulness of the reagent strip that the haematuria results (Figure 3.11) paralleled the findings of the parasitology (Figures 3.12 & 3.13). The reinfection noted from the overall data in Figures 3.8 & 3.9 can be seen to be largely occurring in the younger age groups (Figures 3.10–3.13). Reinfection decreases from the 7–9yr group to the 16–20 yr age group which could be due to either decreasing water contact or increasing immunity. Chandiwana & Woolhouse (pers comm) have shown that in Zimbabwe water contact actually increases from 7 to 15 years old.

Wilkins et al (1987) showed that reinfection with *S. haematobium* decreased with age despite the same amount of water contact and the present data support this finding and also suggests that susceptibility decreases from 9 years of age. Butterworth et al (1985) reported that after treatment older children were less susceptible to reinfection with *S. mansoni* than younger children. This relationship was not evident from the findings of the present study (Figures 3.14 & 3.15) and, whilst this may be attributable to the low prevalence of *S. mansoni* in the study area, it could also suggest that any immune protection against *S. haematobium* infection has little if any cross protection for *S. mansoni*.

In conclusion reagent strip haematuria has been shown to be a good indicator of *S. haematobium* infection that can be used repeatedly on the same population with confidence. The examination is also very rapid and is most sensitive for heavy infections. The impact of repeated treatment on the prevalence and intensity of *S. haematobium* was initially very good with an interval between treatment and re-examination/ treatment of 6 months (Figures 3.8 & 3.9). When the interval was increased to 12 months there were clear indications of significant reinfection both parasitologically (Figures 3.10 & 3.11) and from increased incidence of haematuria (Figures 3.8 & 3.9) which could be associated with a greater incidence of infection in younger school children. Further studies of treatment interval are required, especially relating reinfection to reappearance of morbidity, in order to determine the most cost effective treatment and examination programme.

3.8 AGE PREVALENCE SURVEYS.

Table 3.27 shows the numbers of people sampled on each occasion in each age group for the measurement of the impact of the study on age prevalence. The same individuals were examined for *S. mansoni* and *S. haematobium*. The test for significance was carried out using Chi^2 with Yates correction in a contingency table of *S. haematobium* vs *S. mansoni* for each age group each year.

3.8.1 *S. haematobium.*

The age prevalence for *S. haematobium* for the four sampling periods is shown in Figure 3.18. The data for 1985 represents the pre-treatment situation. The 1986 survey was three months after a schools treatment whereas 1987 and 1988 surveys were 7 to 8 months after a treatment. All surveys show a lower prevalence in the target treatment age groups of 6–20yrs than was found in 1985 at the beginning of the programme and this reduction is most marked in the age group 10–15yrs.

Table 3.27: The sample size by age group is shown for the annual age prevalence studies 1985 to 1988. Also shown are those age groups where significant associations were found between *S. mansoni* and *S. haematobium* infections (* = P<0.05).

AGE GROUP (yrs)	S. HAEMATOBIUM number				S. MANSONI number			
	1985	1986	1987	1988	1985	1986	1987	1988
0–3	53	148	98	140	43	97	81	78
4–6	203*	284	249	252	169*	210	191	175
7–9	227	202	129*	118	217	169	114*	81
10–12	224*	192	90	102	206*	157	85	69
13–15	140*	131	64	125	134*	109	62	67
16–20	93	86	84*	111	82	71	70*	60
21–40	254	326	297	359	219	257	252	297
41+	184	221	229	213	155	180	202	178
TOTAL	1378	1590	1240	1420	1225	1250	1057	1005

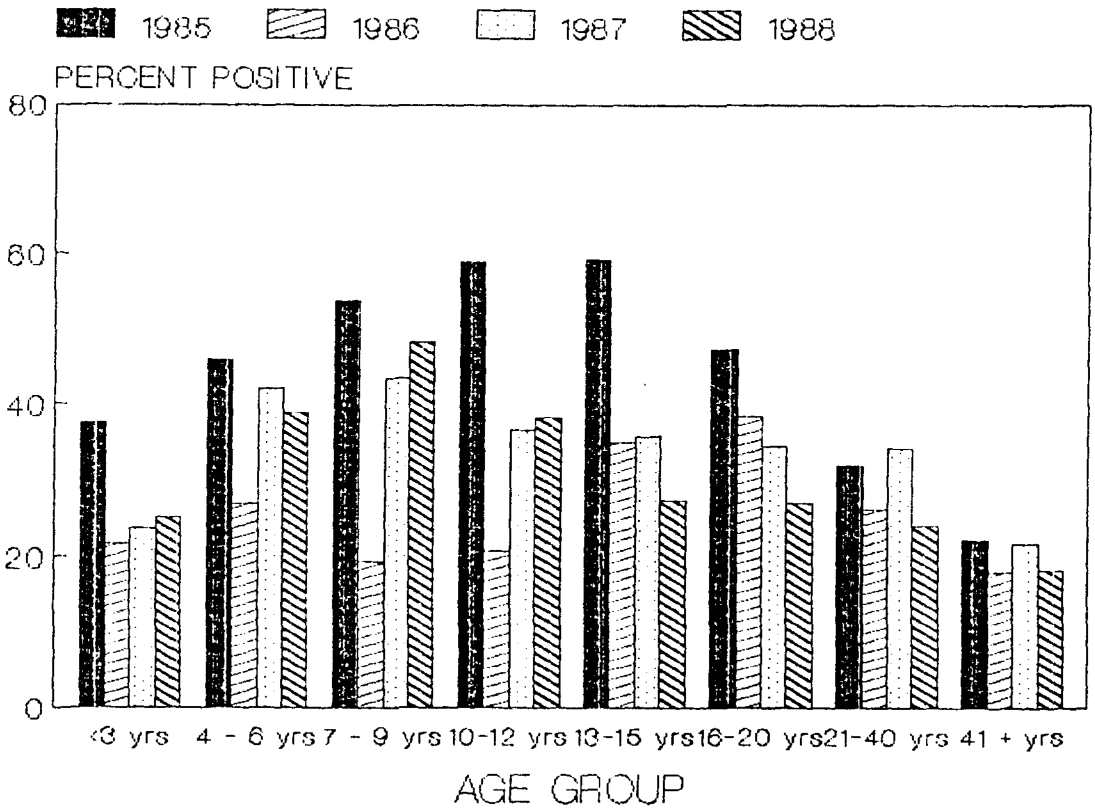


Figure 3.18: Age prevalence of *S. haematobium* in Chaminuka District for 1985 to 1988 showing the percentage of positive people in each age group.

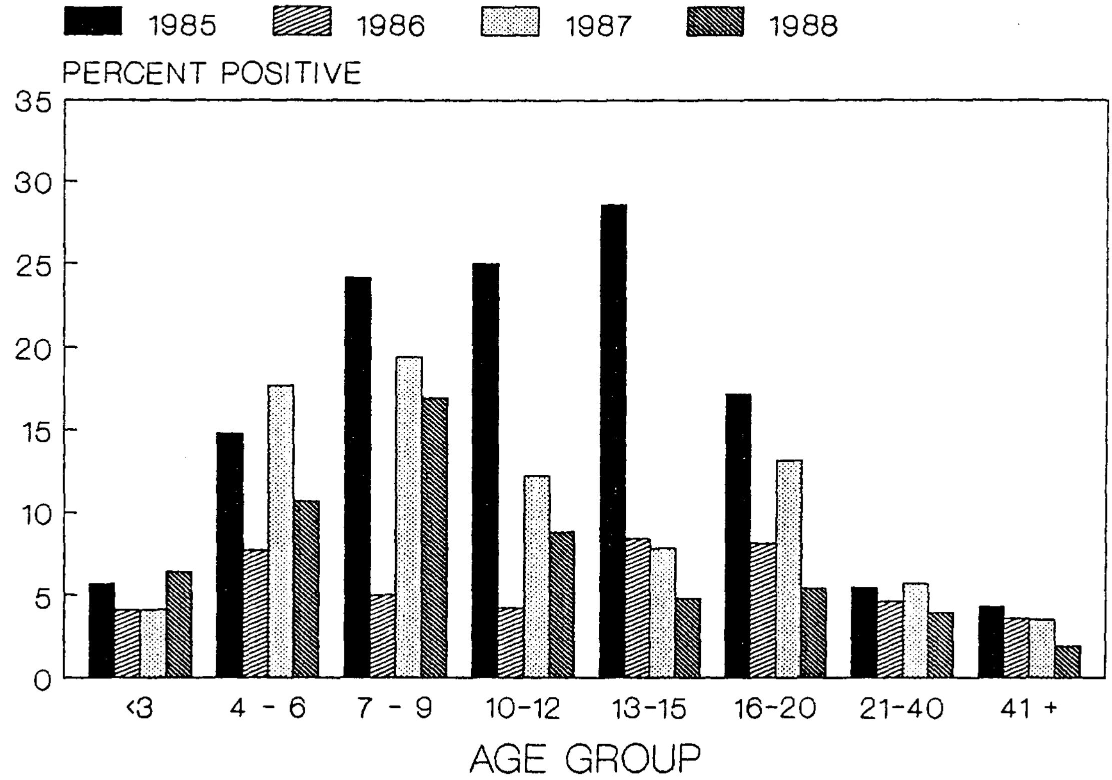


Figure 3.19: Age prevalence of *S. haematobium* in Chaminuka District for 1985 to 1988 showing the percentage of people in each age group with heavy (>50 eggs/10ml urine) infections.

The prevalence of heavy *S. haematobium* infections of over 50 eggs/10ml urine is shown in Figure 3.19.

The greatest reductions in heavy infections are again seen in the 10–15 yr age group (Figure 3.19). The treatments have had a very clear effect in the target groups while the untreated age groups of <3yrs and 21+yrs show little or no change in prevalence (Figures 3.18 & 3.19).

3.8.2 *S. mansoni*.

The age prevalence data for *S. mansoni* are presented for all infections and for heavy infections over 100 epg stool in Figures 3.20 & 3.21.

With the exception of two age groups in 1987 which exhibited a very high prevalence of *S. mansoni* the treatment programme resulted in a satisfactory reduction in the overall prevalence of *S. mansoni* in all of the target age groups (Figure 3.20). The situation was not so clear with regard to the heavy infections as these were generally at a low frequency (Figure 3.21).

3.8.3 Relationship between *S. haematobium* and *S. mansoni*.

A greater than expected frequency of *S. mansoni* occurring as a double infection with *S. haematobium* was tested for using a 2x2 contingency table and Chi^2 with

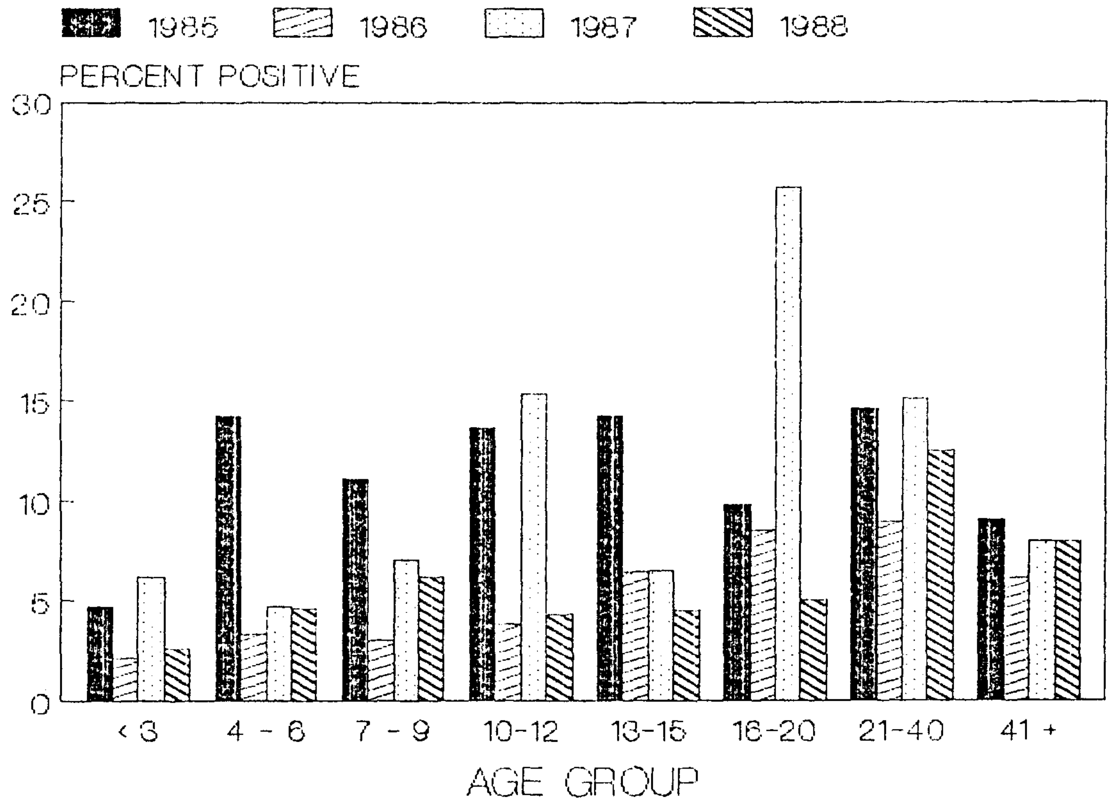


Figure 3.20: Age prevalence of *S. mansoni* in Chaminuka District for 1985 to 1988 showing the percentage of positive people in each age group.

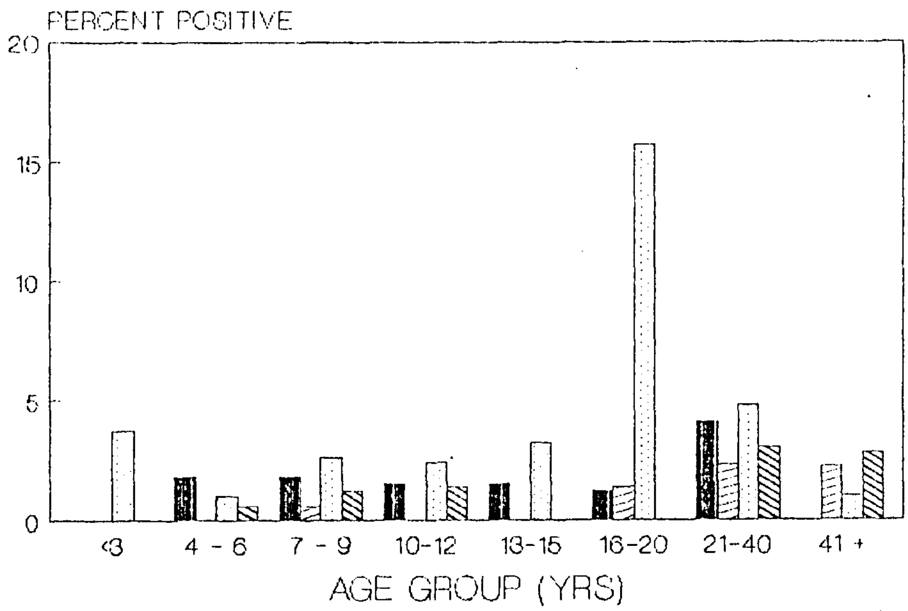


Figure 3.21: Age prevalence of *S. mansoni* in Chaminuka District for 1985 to 1988 showing the percentage of people in each age group with heavy (>100 eggs/g stool) infections.

Yates correction. Pretreatment results for 1985 show that three age groups had a clear relationship between *S. mansoni* and *S. haematobium* infection (Table 3.27). No age groups in 1986 or 1988 showed any such correlation but two age groups in 1987, when more *S. mansoni* was recorded, did show a significant relationship between infection with *S. mansoni* and infection with *S. haematobium* (Table 3.27). On combining data for all age groups each year there was a highly significant relationship between infection with *S. mansoni* and infection with *S. haematobium* in 1985 ($p < 0.001$) and 1987 ($p < 0.01$) with 66% of the *S. mansoni* infections occurring as double infections with *S. haematobium* in 1985 and 50% in 1987.

3.8.4 Influence of gender on infection.

There was no clear or consistent pattern of influence of sex on likelihood of infection with either *S. haematobium* or *S. mansoni* with the exception that whenever there was a significant difference between the sexes it was always the females who had the higher prevalence of infection. Within age groups significant differences were only found in infection with *S. haematobium*. Females in the 21–40yr age group in 1986 and 1987 and the 41+ yr group in 1987 had significantly higher ($p < 0.05$) prevalences of infection than males. There were no significant differences by age group in *S. mansoni* infection.

Combining all ages there were no differences in prevalence of *S. haematobium* infection between male and female in any year. Females had a significantly higher prevalence of infection with *S. mansoni* than males in 1986 ($p < 0.05$) and 1987 ($p < 0.001$).

3.8.5 Discussion.

A typical age prevalence pattern for *S. haematobium* infection was seen in the Chaminuka community when the first examination took place in 1985 (Figure 3.18) with the peak prevalence and intensity in the 10–15 yr age group.

The haematuria based treatment programme clearly had an impact on the prevalence and intensity of *S. haematobium* and *S. mansoni* in the Chaminuka community with the most impact being seen in the age group 10-15yrs (Figures 3.18–3.21). Here there was a major reduction in the age related peak of *S. haematobium* prevalence and heavy infection (Figures 3.18 & 3.19).

School surveys have shown that following treatment, reinfection is greatest in the age group 7–9 years and suggest that immunity may be playing a role in protecting older age groups. The present data show a lack of sustained benefit from the three treatments in the target age groups under 10 yrs, also suggesting that reinfection is taking place rapidly. These findings may suggest that treatment of children to control infection will be most cost effective if targeted at those likely to have developed some protective immunity.

Sukwa et al, (1987) treated an *S. mansoni* infected population 4 times within 12 months with praziquantel yet was still left with a significant number of infected people whereas other studies have shown good cure rates at 6 months or even 2 years post treatment (Mott et al, 1985c; Davis et al, 1981) which is most likely due to seasonal or spatial differences in transmission potential. What is clear from the present results and also from the work of Sukwa et al, (1987) and Wilkins (pers comm.) is that chemotherapy alone is unlikely to provide an acceptable form of intervention due to the likely high frequency of retreatment required. Until the relationships between intensity and duration of infection and morbidity are better understood chemotherapeutic interventions will continue to be based on control of infection rather than control of morbidity.

The importance of school age children in the transmission of schistosomiasis has been shown (Pugh, 1979; Pugh & Gilles, 1978) and several authors have demonstrated that the reagent strip is most useful for diagnosis of *S. haematobium* infection status in this group (Mott et al, 1985a; 1985b; Pugh et al, 1980). Children are therefore the most important target of a schistosomiasis control programme using reagent strip diagnosis but the present study has shown that considerable impact can only be seen in the older target age groups. No effects of treatment were seen in non target groups in the present study (Figures 3.18–3.21) but the impact of targeted chemotherapy on adult, non target age groups, needs to be evaluated over a longer period. At the present time their is no evidence that treatment of teenagers will have a sustained effect lasting over many years into adult life, and there is no evidence that treatment of the most heavily infected section of the community, children, will significantly affect transmission (Davis, 1981).

In areas where both *S. haematobium* and *S. mansoni* occur it is likely, due to the similar conditions required for transmission, that a higher proportion than expected of the infections of the less common species are found as double infections with the dominant species. The present study showed that pre intervention 66% of *S. mansoni* infections were double infections with *S. haematobium* ($p < 0.001$). Thus chemotherapy which is targeted to *S. haematobium* may achieve considerable control over *S. mansoni* when a broad spectrum drug, such as praziquantel, is used.

In conclusion, it has been shown that diagnosis of *S. haematobium* infection in school children with reagent strips and treatment with praziquantel may have only a limited effect on the age prevalence of schistosomiasis in the community and has most impact on the 10 to 15 year age group.

A reduction in transmission following the treatment of the age group mainly responsible for contamination (Pugh et al, 1980; Pugh, 1979) may have some long term impact on the prevalence in the non target age groups provided the reduction in prevalence and intensity can be maintained but this needs further investigation. With increasing evidence of rapid reinfection (Taylor et al, in press; Sukwa et al, 1987; Wilkins, 1987) chemotherapy is likely to be most successful in schistosomiasis control when carried out in conjunction with other control measures.

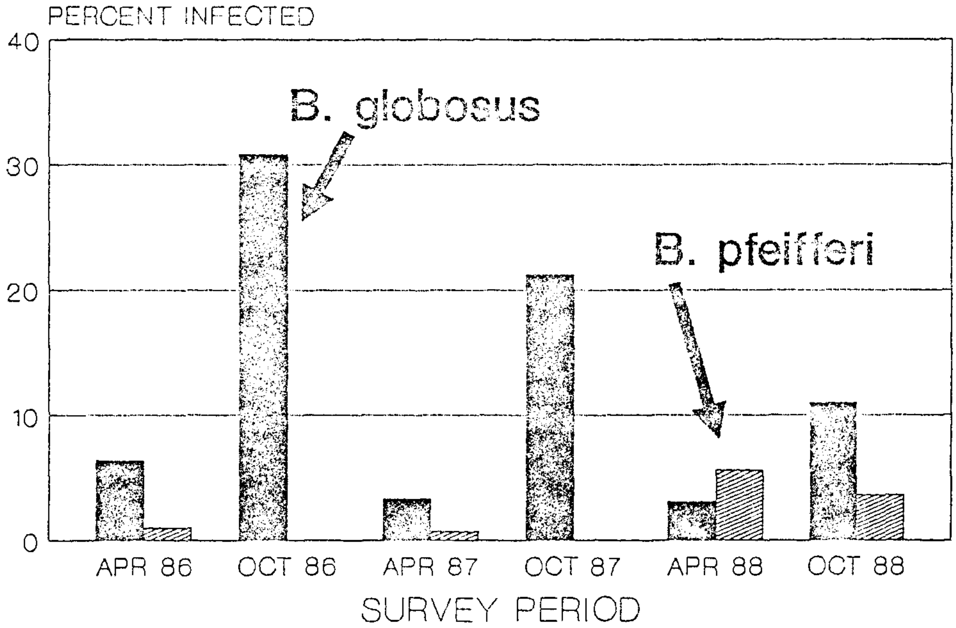


Figure 3.22: Seasonal and annual change in the percentage of *B. globosus* and *B. pfeifferi* infected with human schistosomes for Madziwa and Bushu combined.

3.9 SNAIL SURVEYS AND TRANSMISSION POTENTIAL

Snail surveys were carried out for *B. globosus* and *B. pfeifferi* in Wards 1 to 9 (Madziwa) and Wards 10 to 12 (Bushu) in April and October each year from October 1985 to October 1988. No data on infection status are available for the 1985 survey.

There was drought during much of the study period resulting in some sites being dry, usually during the October surveys. The number of sites examined on each sampling occasion was; 10/85, 65; 04/86, 65; 10/86, 60; 04/87, 61; 10/87, 26; 04/88, 64 10/88, 57.

There was no consistent difference between Wards in the numbers of snails of each species caught or in the proportion infected. The seasonality of infection, and therefore transmission potential, is shown by reference to Figure 3.22.

Infection in *B. globosus* is consistently much higher in October than April whereas such a pattern is not obvious for infection in *B. pfeifferi* which had only very few snails infected. There is a general decline in *B. globosus* infection rates over the study period which is not followed by infection rates for *B. pfeifferi* (Figure 3.22).

Overall 1166 *B. globosus* and 433 *B. pfeifferi* were collected in Madziwa from April 1986 - Oct 1988 of which 14.4% and 1.4% respectively were infected with

Table 3.28: Population size per 50 scoops for *B. globosus* and *B. pfeifferi* summarised for Madziwa and Bushu on each sampling occasion from Oct 1985 to Oct 1988.

DATE	SPECIES	MADZIWA	BUSHU	TOTAL
Oct85	B.globosus	26.0	27.1	26.2
	B.pfeifferi	24.0	8.9	20.8
Apr86	B.globosus	16.8	14.8	16.3
	B.pfeifferi	5.9	8.2	6.5
Oct86	B.globosus	9.0	24.6	12.3
	B.pfeifferi	2.6	4.7	3.0
Apr87	B.globosus	15.6	20.2	16.7
	B.pfeifferi	7.3	3.1	6.3
Oct87	B.globosus	10.8	8.4	10.2
	B.pfeifferi	10.4	1.8	8.2
Apr88	B.globosus	5.7	4.2	5.3
	B.pfeifferi	1.1	1.2	1.1
Oct88	B.globosus	16.8	9.4	14.8
	B.pfeifferi	4.6	0.7	3.6

human type schistosomes. Over the same period 433 *B. globosus* (5.8% infected) and 120 *B. pfeifferi* (0% infected) were collected from Bushu. Madziwa recorded higher infection rates than Bushu although this could be ascribed mainly to the influence of two or three sampling occasions where high infection rates were found.

When snail populations are standardised for the number of scoops (Shiff & Clarke, 1967) (Table 3.28) there are no consistent differences between Madziwa and Bushu in population size, the populations of both species do not change significantly during the course of the programme and there are no trends in relation to season.

B. globosus has a consistently higher population than *B. pfeifferi* in both study areas. Combining the results from both Madziwa and Bushu the population data are presented in Figure 3.23. It is not possible by examining the snails for infection to determine the species of infecting schistosome. *B. pfeifferi* can only be host to *S. mansoni* of the human type schistosomes so with this species it is clear. Unfortunately *B. globosus* is host to both *S. mattheei*, a cattle schistosome in southern Africa, and *S. haematobium* which are indistinguishable by visual examination of the cercariae. In order to determine the species of schistosome, their relative abundance and seasonality, hamsters were paddled in the water at one of the sites in each Ward as described in the methodology. The number of worms recovered per hamster is shown in Table 3.29.

There was a great variation in infectivity between sites and between successive samples from the same site. Pooling the results from the Wards of Madziwa and the Wards of Bushu did not show any seasonality (Table 3.30) unlike that exhibited for snail infection rates (Table 3.28).

A total of 153 schistosome worms were recovered from hamsters of which 88

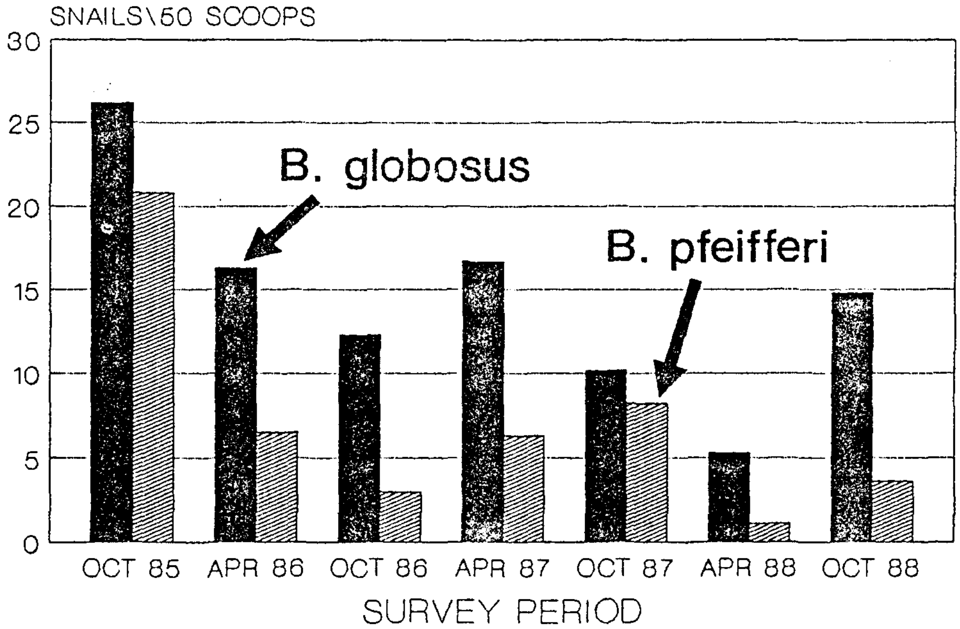


Figure 3.23: Seasonal and annual change in snail population density (snails / 50 scoops) for Madziwa and Bushu combined.

Table 3.29: Infectivity of hamster exposure sites for Madziwa and Bushu by Ward expressed as the number of schistosome worms per exposed hamster.

	SAMPLING PERIOD					
MADZIWA	Apr1986	Oct1986	Apr1987	Oct1987	Apr1988	Oct1988
Ward 1	0.5	0	0	1.0	1.4	0
Ward 2	0.7	-	0	0	0	-
Ward 3	0	-	-	-	0	-
Ward 4	2.0	0.8	1.3	1.0	0	-
Ward 5	0	-	1.0	-	0	-
Ward 6	0	-	0	-	0	0
Ward 7	5.7	1.6	20.0	1.3	0	0
Ward 8	0	-	3.7	-	0	0
Ward 9	0	-	3.3	-	0	0
BUSHU						
Ward 10	0	-	3.0	-	0.4	1.3
Ward 11	0	-	-	1.0	0	-
Ward 12	2.5	3.0	-	1.0	0.6	1.3

Table 3.30: Seasonality of infectivity of water contact sites in Madziwa and Bushu as shown by the infection of sentinel hamsters.

	SAMPLING PERIOD					
	Apr1986	Oct1986	Apr1987	Oct1987	Apr1988	Oct1988
Madziwa	0.85	0.85	2.13	0.81	0.21	0
Bushu	0.77	3.0	3.0	1.0	0.33	1.22
Total	0.83	1.00	2.22	0.85	0.25	0.43

Table 3.31: Species of schistosome identified from hamsters exposed to natural water in Bushu and Madziwa.

	MADZIWA	BUSHU
S. haematobium	27	9
S. mansoni	31	0
S. mattheei	7	14
Unidentified	48	17
Total	113	40

were identified (Table 3.31) .There was a clear species difference between Madziwa and Bushu as *S. mattheei* constituted 10.8% of identified worms in Madziwa but 60.9% in Bushu. No *S. mansoni* worms were recovered in Bushu but 31 (47.7%) were recovered from Madziwa.

There appeared to be very little difference between Madziwa and Bushu in terms of transmission potential (Table 3.32). Bushu recorded a slightly higher *B. globosus* population than Madziwa and also a higher percentage of infected hamsters. However the average number of worms per hamster was lower indicating lighter infections in the Bushu hamsters. Bushu demonstrated a predominance of *S. mattheei* and therefore it is likely that Madziwa is more important than Bushu in terms of transmission of human schistosomes.

3.9.1 Discussion.

The role of snail vectors in the transmission of schistosomiasis in Zimbabwe has been well described (Shiff et al, 1975; 1979; Chandiwana et al, 1987c). The two seasonal peaks of transmission were identified by Shiff et al (1975) as being at the end of the rainy season (Mar/Apr) and the hot dry season (Sept/Oct). The

Table 3.32: Relative potential for schistosomiasis transmission in Madziwa and Bushu in terms of snail populations and hamster infection rates.

	MADZIWA	BUSHU
B. globosus / 50 scoops	12.8	15.1
B. pfeifferi / 50 scoops	4.7	4.2
% infected hamsters	21.7	32.6
Ave. worms / hamster	0.8	0.3

present study has shown the October peak to be the most important for infection of *B. globosus* whilst there was no clear difference between the two seasons for *B. pfeifferi* (Figure 3.22). It was interesting to note the decline in October snail infection rates for *B. globosus* across the study period and whilst this could be ascribed to a declining transmission as a result of the treatment programme this would require further corroboration.

The focal mollusciciding programme for Madziwa carried out in July 1986 did not apparently affect the snail population for any length of time as the impact was not clearly discernable in the following sampling period. Whilst the proposals for intervention at this time (Shiff et al, 1978) appear theoretically sound it may be that blanket application of molluscicide is necessary to achieve any sustained effect on both the snails and infection rates.

It is important to identify the species of infecting schistosome where possible as the presence of *S. mattheei* in southern Africa can lead to a misleading interpretation of snail infection rates (Chandiwana et al, 1987c). This was clearly seen from the schistosome identification results from Madziwa and Bushu. Although only 50% of worms were identified the results demonstrated the importance of *S. mattheei* in Bushu and the absence of *S. mansoni*. In contrast *S. mattheei* was at low frequency in Madziwa and *S. mansoni* was relatively common.

It has also been concluded by other workers (Shiff & Clarke, 1967; Farooq et al, 1966 ; Chandiwana & Christensen 1988) that snail monitoring is an effective means of evaluating the impact of intervention measures in the control of schistosomiasis. Snail population size, when sampled from only a small number of sites on a monthly basis, can be very erratic due possibly to a combination of the patchy nature of snail distribution and the adverse effect of frequent habitat disturbance. The 6 monthly sampling programme of a large number of sites adopted in the present study may provide information of population and infectivity changes from year to year which is adequate for most studies of long term interventions.

Chapter 4

CONCLUSIONS

This project set out to run a pilot integrated schistosomiasis control programme in order to determine the framework within which a national programmme could operate.

Apart from research activities most other aspects of the programme involved the community. In many respects this was the most instructive part of the project as the community issues to be resolved were many and various. Considerable advantages were gained by using personnel familiar with the community but it was clear from the outset that there is no defined route by which to ensure a successful outcome. The most important lessons were that the pace of the programme cannot be determined from outside the community and that the community must want the outcome of the project.

In the present study the community clearly expressed a need for improved water supplies and sanitation and also identified schistosomiasis as one of their health problems during a pre implementation KAP study. The District Council had also committed itself to supporting the project although such committments do not necessarily imply that community support will actually be forthcoming.

It is particularly important to be flexible in ones approach to the community as each village may have its own specific agenda or customs to be satisfied although this may not be possible when the project approach is determined from outside. For example in the present study we encouraged families to build latrines by offering cement to those families who had already dug a pit and collected the bricks. This is very much a demand driven approach depending very much on the initiative of the families themselves and one of the consequences that we saw was that adopters tended to be the wealthier families.

Until recently, most other programmes in Zimbabwe have been more coercive in nature where resources are allocated to a community who all have to build at the same time in a much more organised manner. From the experience of these approaches it would be better to find a compromise between them with more emphasis on demand driven than resource driven programmes.

The finding that most families who had ordinary pit latrines built new VIP latrines together with the increased sharing of latrines is encouraging. It suggests that the families with latrines recognise the benefits and are prepared to invest in improving them. Thus not only are social pressures likely to encourage most families to have a latrine but in future the family is likely to replace the latrine using its own resources.

Communities contributed considerably to the development of new water resources especially when they could assume complete responsibility as when using the drilling rig. Unfortunately there is as yet no system for the support of water committees in Madziwa which leads to demotivation. Also, pumps tend to be replaced or repaired without reference to the committees leaving the community with the feeling that this is not their property and therefore not their responsibility.

The lack of any cost recovery system or payment for water supplies also leaves the community with no obvious rights in the management of their water resources. Some of these issues are receiving active attention at a central policy level and will continue to have a serious adverse effect on community participation in operation and maintenance of water supplies until they are resolved.

Reaching the community for health education proved extremely difficult. The scattered nature of rural communities in Zimbabwe and the lack of any rapid communication system makes health education a time consuming and relatively expensive undertaking. Whilst health education about latrines and safe water can be seen in relation to their own immediate felt needs for better sanitation and clean water, schistosomiasis is not seen as the priority health problem of the community. The best route to the family was felt to be through the schools and the school children and it was felt that the school drama competitions were very successful here. Schistosomiasis is meant to be part of the school syllabus and it was disappointing how few children could actually coordinate the life cycle.

It is vital that an effective health education approach is developed for schistosomiasis as knowledge of the disease is generally poor in the population. The health education process was more difficult and labour intensive than we realised at the outset and not enough use is being made of the existing educational institutions. In the context of schistosomiasis control, health education programmes should be focussed on those specific areas where intervention is planned and should emphasise community theatre.

In relating water usage and schistosomiasis it is very important to distinguish the different uses of water within the household. Most families obtain all drinking water from protected sources or sources with no risk of schistosomiasis. However, the abundant supply of water at natural water bodies means that most households wash clothes in rivers and streams. The number of water points may not influence this behaviour significantly unless washing facilities are installed at pumps and there are enough pumps that queuing is not necessary. Improved water supplies will have little effect on the transmission of schistosomiasis unless they can actually serve the purpose of attracting people away from natural water bodies.

Improved sanitation has been provided at the family home. Of itself this may not influence schistosomiasis transmission very much and it is probably most important in control of intestinal helminths and diarrhoeal disease. Contamination of water bodies is likely to continue from people engaged in water contact activities or agricultural practices. This reinforces the point that alternative water sources, by reducing human water contact with natural water bodies, reduces contamination as well as infection. The provision of water supplies should go hand in hand with the provision of other amenities at the water point such as washing slabs and latrines. Improved water suplies and sanitation must remain the priority health intervention for sustainable schistosomiasis control.

It was shown very clearly in the present study that reagent strip detection of haematuria is an effective and cost efficient means of detecting *S. haematobium* infection. This has also been shown recently in Pemba, Zanzibar (Savioli & Mott, 1989). The rapid rate of reinfection reported here for Madziwa and Bushu is disturbing in suggesting an economically unacceptable frequency of re examination and treatment. It remains an extremely important priority to extend our knowledge of morbidity in schistosomiasis in order that the proposed strategy of morbidity control (WHO, 1983a) can actually become a reality. Treatment is still based upon infection status and information is still not available on how quickly infection or reinfection leads to the development of measurable morbidity.

The relationship of age to morbidity in *S. haematobium* is currently being investigated in Zimbabwe (Munjoma, pers. comm.) and this could prove very useful in determining age groups for priority action. The present study showed that children aged 8–10 yrs become reinfected much more rapidly than older age groups suggesting extra attention should be focussed on this age group. Unfortunately our knowledge of the immune process in schistosomiasis is still rudimentary and it is unknown whether protecting 8–10 year olds from infection will have the adverse effect of preventing them from developing the immunity which protects them later in life.

Whichever approach to chemotherapy is adopted it must therefore include an extensive monitoring and evaluation component.

This study showed some indication of reduced infection in snails over the project period however a more sustained investigation is required to support or refute this observation. In particular the next phase of the project, which will measure the impact of the improved water supplies and sanitation on transmission of schistosomiasis, is very important in providing continuity to the present studies. Snail monitoring is a labour intensive exercise and although it needs to be part of a schistosomiasis control programme it may be carried out only once or twice per year at selected sentinel sites.

Although this phase of the investigation did not intend to assess directly the importance of water supply and sanitation to schistosomiasis control it is clear that sustainable progress will not be made with current tools unless the control programme is closely linked to an improvement in the social environment in general and water supplies and sanitation in particular. The policy in Zimbabwe of developing schistosomiasis control programmes only in those areas where improved water and sanitation has been achieved, is realistic given Zimbabwe's progress in this direction but may still be constrained by the cost of repeated examination and treatment of a high proportion of the population.

Chapter 5

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